Affected Environment

Fluvial Processes and Sediment Transport

Even though no changes to fluvial processes or sediment transport are expected as a result of implementing the mitigation facilities in the proposed action, the dynamics of these processes are important to understanding impacts to water quality and fisheries. For more information on any of the topics analyzed in this SEIS, the reader should refer to the 1996 FEIS.

Sediments in the Elwha River drainage basin are dominated by glacial deposits and recent alluvium. Sediments range in size from clay to boulders. River alluvium typically consists of sand, gravel, cobbles, and boulders. Considerable amounts of recent alluvium are stored along the river channel, particularly in the wide terraces outside the floodplain and at the river mouth.

The Elwha River has a steep slope. It is steepest at the headwaters (16% average gradient) and generally decreases in slope farther downstream. The river flows through several steep, narrow, bedrock canyons. Between these canyons, the channel is less steep and has wider reaches within its broad floodplains. At the outlet of the canyons, deltas are created where the channel widens, the streamflow slows, and sand, gravel, cobbles, and large woody debris are left behind by the slower-flowing river. In the floodplain the river typically meanders, in some cases undercutting alluvial terrace and valley wall deposits.

The Elwha and Glines Canyon dams have blocked sediment flow downstream.

- The Glines Canyon Dam has trapped an estimated 13.8 million cubic yards of sediment; it has also created the Lake Mills delta, which inundated a 2.5-mile stretch of the river. The upstream portion of the delta in Rica Canyon and in the Cat and Boulder Creek fans consists of approximately 1.55 million cubic yards of mostly coarse (i.e., sand-sized and larger) material. The main delta contains 6.97 million cubic yards, which is 70 feet thick in some places. Downstream of the delta, Lake Mills contains 6.6 million cubic yards of fine lake sediments composed primarily of silt and clay, with minor amounts of sand. This material is spread fairly evenly across the lakebed. It is an estimated 12-feet thick along the center of the reservoir and thins toward the edges. Most of the sediment is composed of silt-sized particles. The clay-size particles have little cohesion and lack many common properties of clay.
- The Elwha Dam has trapped approximately 3.88 million cubic yards of sediment in Lake Aldwell and its delta, which has inundated 2.8 miles of the Elwha River. The reservoir area consists of two wide alluvial reaches divided by a canyon. The delta contains an estimated 1.78 million cubic yards, as much as 40 feet thick, composed of sand and gravel with smaller amounts of clay, silt, cobbles, and boulders. Downstream of this delta, the reservoir contains 2.1 million cubic yards of fine-grained sediments, with minor amounts of sand. This material is 5–6 feet thick in the southern basin, thinning to less than 1 foot in the narrow canyon section.

From the Elwha Dam downstream to RM 4, the river is constrained by steep bedrock walls of Elwha Canyon. Below Elwha Canyon the stream gradient is less steep and the channel floodway widens to approximately 1,500 feet. Farther downstream are DCWA wells at RM 3.7, the City of Port Angeles diversion and industrial surface water intake (RM 3.5), the Ranney collector adjacent to the channel for municipal water (RM 2.8), and the WDFW fish-rearing channel (RM 2.8–3.0). At RM 2.8 the river channel narrows where it is constrained by bedrock on the right bank.

Between RM 2.8 and the river mouth, the floodplain widens and is bound on the west side by steep cliffs of glacial deposits more than 150 feet high. The pre-dam river migrated throughout the entire floodplain; nearer the mouth, it moved laterally over an area 1.2 miles wide. The erosive action of the meandering river prevented the establishment of a mature evergreen forest. But dam construction has caused the channel to shift less frequently and dense, woody vegetation has grown near the mouth, increasingly constraining the river in the lower reach. The 1.5-mile-long lower Elwha federal flood control levee on the east side of the floodplain constrains the eastward migration of the river. A 900-foot-long privately owned levee downstream from the high river bluffs on the west side of the river also restricts the floodplain near the river mouth.

At the mouth of the river an extensive delta roughly 5 miles wide, 6 miles long, and an estimated 200 feet thick has formed. It is composed of sand, gravel, and cobbles, and samples indicate a sand and gravel surface to approximately 2,000 feet offshore (USACE 1971). Because the dams have blocked much of the natural sediment transport, the only current source of delta sediment is from the erosion of loose material (alluvium) from the bluffs along the west side of the river in the 4.9 miles upstream from the mouth. As a result, sediment yields to the delta have dropped from a pre-dam total sediment supply of 280,000 cubic yards per year to 5,900 cubic yards per year, approximately 2% of the pre-dam volume (FERC 1993).

Sediment from the Elwha delta moves with the currents in the strait, predominantly in an eastward direction along the coast. The sediment nourishes beaches and nearshore areas with sand and gravel, and supplies some of the sediment to Ediz Hook, which forms the bayward side of Port Angeles Harbor (FERC 1993). The drastic reduction in bedload sediment supply from the river has caused 75–150 feet of beach erosion along the western edge of Ediz Hook (FERC 1993).

Flooding

The floodplain between the dams (from Glines Canyon Dam to the U.S. Highway 101 bridge at the head of Lake Aldwell) can be characterized as a largely undeveloped, relatively narrow floodplain confined by steep, forested valley side slopes. The river gradient in these sections averages 40 feet per mile, and the river flows swiftly. There is no development within the 100-year floodplain on the west side of the river between the dams, but five residential properties (four near RM 8.4, one near RM 9.7) lie within the floodplain on the east side of the river. Four of these residences are vulnerable to 5- to 25-year floods, and the fifth residence was recently constructed on a raised metal platform. Portions of the Olympic Hot Springs Road (Elwha Valley Road), paralleling the east side of the river channel, and the Elwha and Altair campgrounds in Olympic National Park also lie within the 100-year floodplain. The Elwha Ranger Station facilities near RM 12.1 are just 1 foot above the 100-year floodplain. In addition to their location in the floodplain, both Hot Springs Road and the Elwha Ranger Station are vulnerable to loss through bank erosion following dam removal. Monitoring to determine whether bank erosion is occurring would take place during dam removal, and bank protection in the form of large angular rock, engineered log jams, or a combination of the two would be applied as needed to stabilize the bank.

The area from the Elwha Dam to RM 4 is forested and relatively undeveloped. In the broad floodplain between the old Highway 112 bridge (at RM 3.3) and RM 4, two residential properties on the west side of the river and one on the east side are flooded every 10 to 30 years on average; these residences lie approximately 3 feet below the current 100-year flood elevation. The DCWA wells and wellhead access road on the east side of the river are also within the 100-year floodplain.

Compared to the middle reach of the river, the floodplain along the lowest 3 miles broadens significantly and has a much lower gradient (approximately 15 feet per mile). Development in this portion of the 100-

year floodplain includes the state fish-rearing facility, the Port Angeles domestic water supply system, the federal flood control levee on the east side of the river, and residences on the west side near the river mouth.

Levees

The 7,100-foot-long federal Elwha flood control levee was constructed in 1988 by the U.S. Army Corps of Engineers in the lower 1.5-mile floodplain on the east side of the river. Approximately 300 acres of Lower Elwha Klallam Reservation lands between the levee and the river are dedicated to flood abatement. The levee, designed and constructed to withstand a 200-year flood, was built to protect structures in the 700-acre floodplain, including 305 acres east of the levee on Lower Elwha Klallam Reservation and private property. Annual operation and maintenance of the levee is the responsibility of the tribe, the local sponsor of the project. However, under the current agreement with the Army Corps of Engineers, any levee damage or imminent threats of outflanking may be addressed as a mitigation measure by the Corps or a subcontractor. Structures within the floodplain now protected by this levee include approximately 60 houses, a community tribal center, two churches, a Head Start facility, a dental clinic, a tribal fish hatchery, the housing authority, a child care facility, the human services facility, and agricultural lands.

Approximately 30 acres of residential development on the west side of the river are protected against lower frequency (25- to 50-year) floods by a privately owned and maintained levee. This 900-foot-long levee extends downstream to near the mouth of the river from the high natural bluff line, preventing the river from migrating to the west beyond the shore zone. Flooding at the mouth of the river is also influenced by tidal conditions.

Flooding Frequency

The Elwha River typically experiences two periods of high runoff — November through March runoff from rainfall, and May through June from spring snowmelt. Annual peak discharges have ranged from 4,680 cfs in 1936 to 41,600 cfs in 1897. The largest recent discharges were 25,900 cfs on October 17, 2003, and 25,000 cfs on October 21, 2003 (provisional data from USGS). Typically, flood discharges rise sharply (usually less than 24 hours to the peak) and gradually recede over two days or more. It is not uncommon for two or more periods of high flows to follow one another in swift succession, such as occurred on October 16 and 20, 2003 (25,370 cfs and 24,650 cfs, respectively).

Statistics compiled since 1924 show that the flood stage in the Elwha and the neighboring Dungeness and Hoh Rivers is increasing over time. For example the predicted peak flow for 2002 is nearly double that predicted for 1924 (Crain, pers. comm. 2003). Some of this trend may be related to logging and other land clearing activities (primarily in the neighboring drainages), but it appears climate is having a major effect as well.

Both the Elwha and Glines Canyon dams are operated in a “run-of-the-river” mode, in which the reservoir level is held constant and very little of the water entering the drainage is stored or released differently from the way it was before the dams were built. This is done to maximize power production, and not much storage for flood control is available in the reservoirs without stopping power production altogether. Consequently, the dams provide minimal flood protection and only during short-duration storms or snowmelt.

Since the dams were built, relatively little bedload entered the river downstream of the dams, allowing the riverbed to degrade (become lower at some locations), which has reduced the flood hazard from pre-dam conditions to some properties along the lower river. Many homes, wells, and cultural resources within the 100-year floodplain will be more susceptible to flooding after the removal of the dams.

Surface Water

Elwha River

Discharge

Annual precipitation in the Elwha River basin ranges from 220 inches in its upper reaches to 35 inches near its mouth. Average annual discharge is approximately 1,500 cfs at the McDonald Bridge stream gage and 1,650 cfs (about 10% higher) at the river mouth. Discharge is influenced by winter storms and spring snowmelt and by baseflow conditions during the summer and fall. The lowest flow period is during late summer and fall, when discharges average from 618 cfs to 952 cfs. Flow regimes of the river and its tributaries are nearly natural because the dams are operated in run-of-the-river mode.

Water Rights

Of the 206 cfs of state-issued water rights on the Elwha River, the City of Port Angeles holds 200 cfs — a 50 cfs groundwater right for municipal purposes at the Ranney collector at RM 3.0, and a 150 cfs surface water right for the industrial intake channel at RM 3.5. The surface diversion currently provides water to two users — the NPI paper and pulp mill and the WDFW fish-rearing channel. Private landowners, the Dry Creek Water Association (5.58 cfs), and the Elwha Place Homeowners' Association (0.4 cfs) also hold groundwater rights. The Lower Elwha Klallam Tribe and the tribal fish hatchery withdraw approximately 10 cfs. The United States holds additional unquantified water rights in trust for the tribe; these rights are not issued by or registered with the state. They guarantee sufficient water to support treaty fisheries and the purposes of the Lower Elwha Klallam Reservation.

Water Quality

The Elwha River and its tributaries are classified by the Washington Department of Ecology as a "salmon and trout spawning, core rearing, and migration" area, signifying "extraordinary" quality. Overall, the Elwha has relatively low concentrations of dissolved and suspended sediment loads, nutrients, and organics (see Table 6). Changes in water quality occur in the lower part of the watershed, mostly as a result of reduced sediment load and elevated water temperatures during the summer. Suspended sediment concentrations and turbidity of the lower river are related to the reservoir's trapping efficiency, flood flows, logging, agricultural practices, and bank erosion. Values for pH and alkalinity indicate neutral to slightly alkaline conditions typical of oligotrophic (low biological productivity) waters (Wetzel 1975). Dissolved oxygen values are very close to saturation at all times of the year; these are excellent conditions for cold-water fish (EPA 1976). Most water quality parameters vary little with time except for turbidity and suspended sediments, which increase during high discharge periods.

The City of Port Angeles Ranney collector, a large diameter caisson near the river's edge with laterally radiating perforated collection pipes beneath the riverbed, has the capacity to pump approximately 17 cfs. Generally, Ranney collector water is lower in turbidity than river water because alluvial sands and gravels filter out a large portion of the particulate matter. The 1994 measured mean turbidity of 0.08 NTU (nephelometric turbidity units — a measure of how much light is scattered by particles in the water) is below the drinking water standard of 1.0 NTU. However, the maximum turbidity detected in the city's well from 1983 to 1993 was 4.8 NTUs, well above the drinking water standard. Mean iron concentrations

Table 6. Elwha River Water Quality Impact Indicators

IMPACT INDICATOR	CURRENT CONDITIONS
Dissolved Oxygen (% saturation)	95–110
Total Suspended Solids (fines) (mg/L)	1–1,500
Turbidity (NTU)	1–2,800+
Total Iron (μg/L)	20–2,300
Total Manganese (μg/L)	4–210
pH	6.7–10
Total Organic Carbon (mg/L)	0–10

SOURCE: USGS water quality data and NPI.

are lower than state drinking water standards, although maximum concentrations are not. Only two constituents, iron and turbidity, were detected above maximum contaminant levels in the Port Angeles Ranney well samples taken from 1983 to 1993.

In April 2000 the Washington Department of Health informed the city that water obtained from the Ranney collector had been designated as "GWI" or "groundwater under the influence of surface water." This change is unrelated to proposed dam removal activities; it means the city must now treat its water to surface water treatment standards, including the removal or inactivation of viruses and *Giardia* cysts. This can be accomplished by appropriate filtration and disinfection, or by reconstructing the Ranney collector to eliminate surface water influence, if possible (URS 2002c). As noted in the "Alternatives" chapter, the city has agreed to build a water treatment facility adjacent to its existing landfill site, and to have surface water pre-treated at the Elwha water treatment plant sent to the Port Angeles plant as a back-up supply during dam removal. Because water collected in the Ranney well is no longer considered groundwater, the impacts of providing a source of treated water to the city's municipal customers is discussed under "Surface Water" in this SEIS.

Morse Creek

The Morse Creek watershed includes four subwatershed areas, including an extensive highland area that lies within old-growth forest inside Olympic National Park (DeMond, pers. comm. Sept. 2002). The headwaters of Morse Creek lie in a subalpine environment above 6,000 feet in the southern mountains of the park. The southernmost divide of the watershed is defined by Hurricane Ridge.

In the lowland subwatershed, the mainstem of the creek lies within a heavily wooded, ravine-like valley outside the park. Vegetation here has been altered through extensive logging, clear-cutting, and land clearing for development and agricultural purposes. The drainage network in this area is poorly integrated, so impacts from these activities have remained localized rather than affecting the entire mainstem of Morse Creek. Rain at this elevation and snow at higher elevations contribute to runoff in the watershed. Chinook-rearing ponds are planned for development in this part of the watershed, approximately 5.5 miles upstream from the mouth of the creek.

Streamflow in the Morse Creek watershed is highest during winter and spring, and lowest during late summer and into fall. The Washington State Department of Ecology rates Morse Creek water quality as a "salmon and trout spawning, core rearing, and migration" area, or extraordinary water quality.

Groundwater

An alluvial sand and gravel groundwater aquifer, which supplies municipal water for local residents and businesses, underlies the Elwha River valley (Bureau of Reclamation 1995). Five major purveyors withdraw groundwater from the alluvial aquifer: the City of Port Angeles (although as noted above, this source is now considered to be hydraulically connected to surface water to such an extent that it has been redesignated as under the influence of surface water and must be treated as if it were a surface water source), the Dry Creek Water Association, the Lower Elwha Klallam Tribe, the tribal fish hatchery, and the Elwha Place Homeowners' Association (EPHA).

Alluvial Aquifer Characteristics (Lower Elwha River)

Above Elwha Dam the alluvial aquifer is restricted to the river channel and the narrow floodplain within the valley; it is bounded primarily by bedrock. The alluvium thickens and laterally extends into the lower Indian Creek valley.

Below Elwha Dam the river valley is divided into three distinct alluvium-filled groundwater subbasins separated by bedrock outcrops or constrictions in the surrounding glacial deposits.

- The upper subbasin (RM 4.0–3.1) is where the river emerges from the narrow, bedrock-walled Elwha Canyon. The alluvium in the 60-acre upper subbasin is estimated to be as much as 75 feet thick. The DCWA wells are located in the upper subbasin.
- The middle groundwater subbasin (between RM 3.1 and 2.8) is approximately 70 acres and includes the Port Angeles Ranney collector and the WDFW rearing channel wells. Drilling in the middle subbasin showed alluvium thicknesses of 55 feet.
- The lower subbasin (RM 2.8 to the river mouth) is approximately 1,100 acres and includes the EPHA wells and the Lower Elwha Klallam Reservation. Drilling in the lower subbasin showed the alluvium was 125 feet thick.

The transmissivity of the aquifer increases from upstream to downstream. In the upper subbasin, the transmissivity is estimated to be 75,000 gallons per day per foot of aquifer; in the middle, 100,000; and, in the lower, up to 400,000.

The alluvial aquifer and the river are hydraulically connected, and both surface and groundwater flow north toward the Strait of Juan de Fuca. Groundwater flows through the aquifer from the upper to the lower subbasin. The discharge from the middle to the lower subbasin is approximately 1–2 cfs. In the lower subbasin, the river loses water to the aquifer; the U.S. Geological Survey estimates the discharge at between 3 and 12 cfs from the alluvial aquifer to the strait (URS 2001).

Groundwater Levels

Lake Aldwell supports an artificially high groundwater level at the east end of the Indian Creek valley, near the confluence of Indian Creek and the Elwha River, which allows at least one well in this area to access groundwater at a shallower depth. Also, residents of the Lower Elwha Klallam Reservation Valley community have been able to install septic systems because groundwater levels are lower now than before the dam was built. This is due to the riverbed degrading without a continued supply of sand and gravel, consequently dropping the river's surface elevation.

Groundwater Use

Total use by the five major groundwater purveyors in the Elwha River valley is approximately 22.3 cfs. In the upper subbasin the Dry Creek Water Association holds a groundwater right for 5.58 cfs, and average use is approximately 0.56 cfs (250 gallons per minute [gpm]). The association wells are at approximately RM 3.7. Because of their proximity to the river channel, turbidity in the river increases turbidity in the two oldest (hand dug) wells. One of these wells has been removed, and the other is reserved for emergency use.

In the middle subbasin the City of Port Angeles holds a groundwater right for 50 cfs. As noted above, because water collected in the Ranney well is considered groundwater under the influence of surface water, the impacts of providing a source of treated water to the city's municipal customers is discussed under "Surface Water" in this SEIS.

In the lower subbasin the Lower Elwha Klallam Tribe community water system and the tribal fish hatchery together withdraw a total of approximately 10 cfs from both wells and a shallow infiltration gallery. The Elwha Place Homeowners' Association holds a groundwater right for 0.4 cfs and uses approximately 0.1 cfs. The EPHA wells are at approximately RM 1.4; their water supply does not become turbid when the river does. Other groundwater withdrawals from domestic wells total less than 0.2 cfs.

Groundwater Quality

The groundwater in the Elwha River watershed is of excellent quality, and the entire headwater area within Olympic National Park is protected. Watershed land use is primarily rural, but non-point source pollution from agricultural and other uses has a minor influence on groundwater quality. Low chloride levels (less than 1 mg/L to 8 mg/L) detected in wells near the mouth indicate that saltwater intrusion has not occurred. Private septic systems in the lower basin present a potential for groundwater contamination because of the poor filtering capability of the coarse-grained alluvial soils and the high water table.

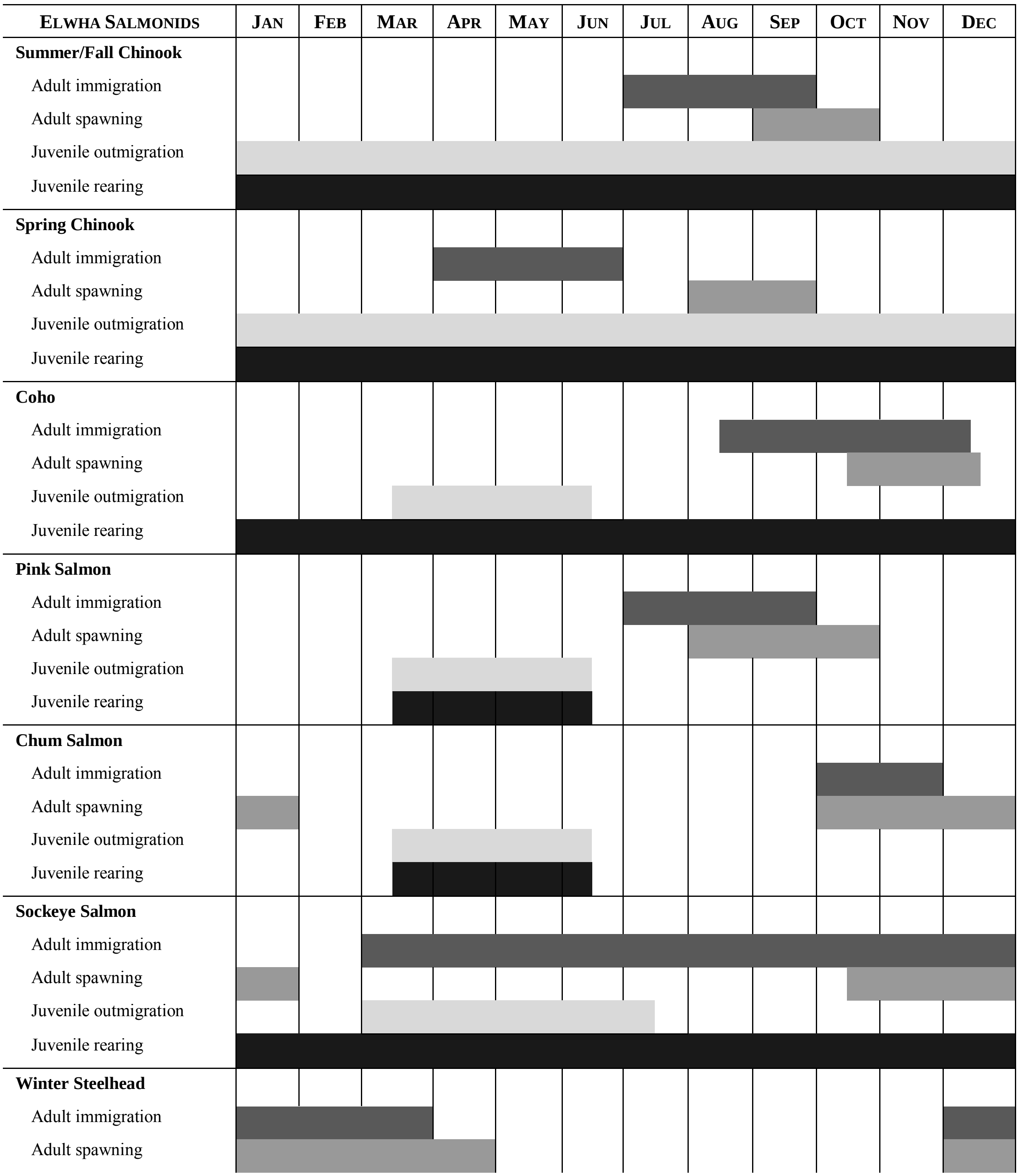
Groundwater withdrawals by the Dry Creek Water Association and the Elwha Place Homeowners' Association are periodically tested for several contaminants, as required by the Washington State Department of Health. Well water that was tested for turbidity, coliform bacteria, inorganic chemicals, trihalomethane, volatile organic chemicals, and pesticides was found to be of very high quality. Volatile organic chemicals were not detected in any samples. Inorganic maximum contaminant levels were not exceeded in any sample taken from the DCWA wells (2003-04) or the EPHA wells (1985–93). Trihalomethane concentrations were below the maximum contaminant levels in all DCWA samples (1989–94).

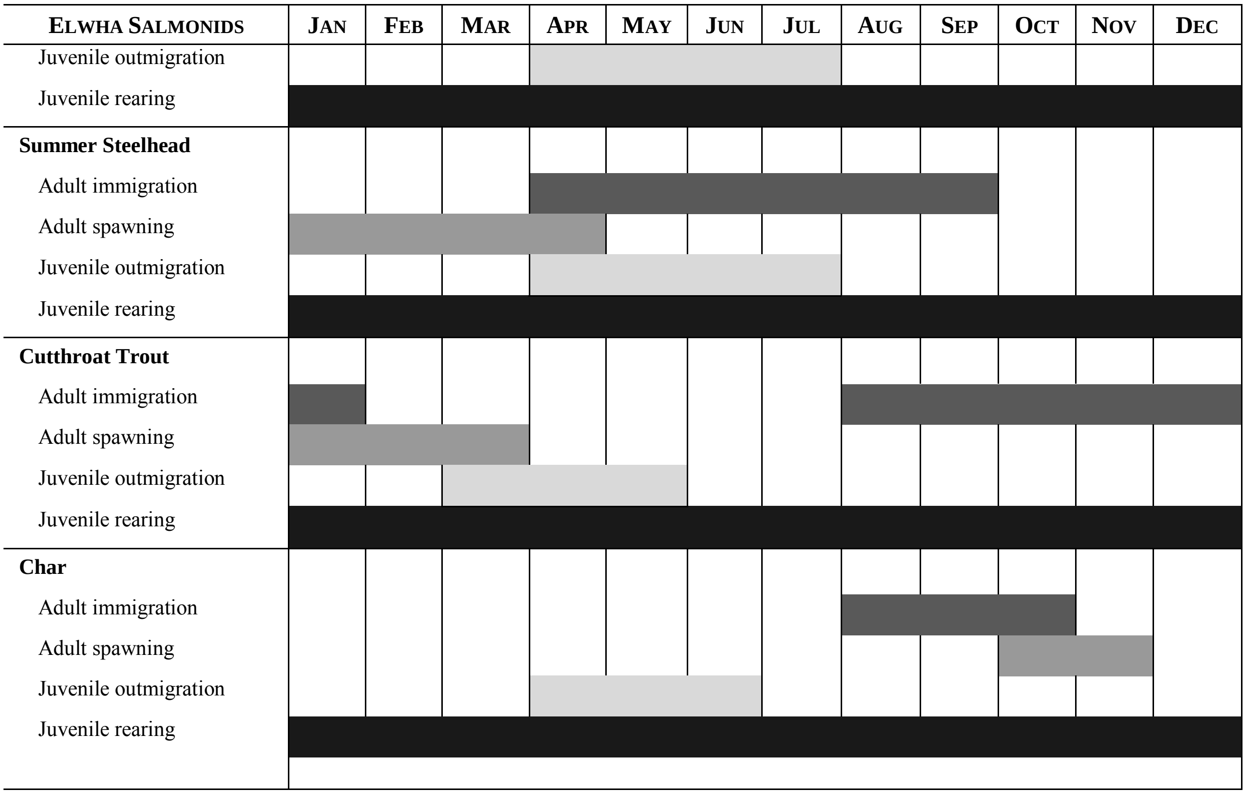
The U.S. Geological Survey tested water resources of the Lower Elwha Klallam Reservation in 1977 and found them to be of excellent chemical quality. The Lower Elwha Klallam Tribe has sampled two of their community wells for complete inorganic and organic analysis. All parameters tested were lower than state maximum contaminant levels.

Native Anadromous and Resident Fisheries

Ten stocks of anadromous salmon and trout are either now present in the Elwha River or, based on data from neighboring rivers or other information, were present before the dams were built (see Table 7). They are winter and summer steelhead trout, coho, summer/fall and spring chinook, pink, chum and sockeye salmon, cutthroat trout, and native char (Dolly Varden and bull trout). Pacific lamprey and brook lamprey have also been documented in the Elwha River. In addition to these anadromous species, the Elwha harbors many non-migrating fish, including sculpins, resident cutthroat, and rainbow trout, and marine species such as flounder are found in the estuary. White sturgeon and smelt also have been observed in this river in the past. Native char, chinook, and coho have special species status and are discussed in that section of this SEIS.

Table 7. In-River Life Cycle Stages of Elwha Salmonids





The Elwha River was legendary for its production of huge chinook; individual fish in excess of 100 pounds were recorded as late as 1930, 18 years after the closure of the river by Elwha Dam (Brannon 1930). The river was also known as a producer of large quantities of pink and chum salmon. Pink salmon were numerous through the 1960s. They appeared to have died out by the late 1980s, but the population is slowly rebuilding at this time.

About 70 miles of the mainstem of the river and its tributaries are estimated to have been available to anadromous species before the dams were built. Steelhead and possibly other species could have traveled as far as 43 miles up the 45-mile mainstem before encountering impassable stretches (James River II 1988). Carlson Canyon Falls at RM 34 may have blocked some species, depending on timing and the condition of the fish. It is unknown but widely speculated that the relatively poor jumping ability of pink and chum salmon may have restricted them to the river below Rica Canyon (RM 16) (James River II 1988).

The Elwha River is currently the largest producer of steelhead and chinook salmon on the Strait of Juan de Fuca and is second only to the Dungeness River for coho. While the salmon and steelhead run sizes appear minor in relation to Washington State’s total production, they are significant contributors to the Strait of Juan de Fuca and Vancouver Island fisheries, with the exception of chum salmon production, which is small compared to other streams emptying into the strait. Nearly all chinook, coho, and steelhead are produced at hatcheries. A chum hatchery program was operated for 10 years but was abandoned in 1986. The tribe relatively recently began taking chum salmon eggs once again and is burying them in egg trays set in the substrate in lower river side channels as an alternative, less invasive enhancement strategy.

Resident trout in the river system are dominated by rainbow trout and, to a lesser degree, native char (Dolly Varden and bull trout). A very small number of cutthroat trout and brook trout are also present

(Morrill and McHenry 1995; Mausolf and Sundvick 1976; Collins 1983). The Elwha drainage is a major wild trout producer on the Olympic Peninsula. Its ranking to other regional streams is not known, but a creel survey conducted on Lake Aldwell, Lake Mills, and the middle reach indicated a high fishing effort in the early 1980s (Collins 1983).

Current condition information is presented below for fish species that are not on the federal endangered species list. Chinook, coho, bull trout, and Pacific and brook lampreys are discussed in the “Species of Special Concern” section.

Pink Salmon

Pink salmon are a major commercial salmon species in Puget Sound, returning primarily every odd year. Elwha River pink salmon production has dramatically declined since 1979, with virtually no fish observed to spawn in 1989 or 1991. However, spawning abundance in the last three cycles (1991, 2001, and 2003) has been increasing, with several hundred fish observed spawning in 2001. The Elwha Tribe collected, and the WDFW genetics lab evaluated genetic samples from Elwha pink salmon to determine if the fish in the Elwha River are related to the Dungeness River pink salmon. Results show that the Elwha River has two discrete populations, based both on entry timing and genetic composition. These stocks are also genetically distinct from pink salmon from the Dungeness River and from Morse Creek. Pink salmon are a Washington State species of concern.

Chum Salmon

Chum salmon are a major commercial species in Puget Sound, infrequently captured by sport anglers. The historic Elwha River chum run, like the Elwha pink run, was considered abundant. During the last two decades, though, the Elwha River has been a small contributor to total chum production in the strait and a very small portion to Puget Sound, with runs to the Elwha River typically less than 1,000 fish and peaking at 1,500 in 1980. Chum are a Washington State species of concern.

Sockeye Salmon

Sockeye salmon are one of the most prized commercial salmon species in Washington, although state-originated runs are small. Sockeye are a species of concern in Washington. All major stocks of sockeye require a river system with a connected lake for spawning and rearing purposes. The only lake in the Elwha River drainage is Lake Sutherland, now inaccessible to adults attempting to swim upstream because of the Elwha Dam. Records from 1982–91 show an in-river harvest of only eight sockeye total over the 10-year period (Hoines 1994); these fish were probably strays and could have come from coastal (Ozette or Quinault), Puget Sound (Baker or Lake Washington), or Fraser River runs. It is also possible that these fish were the returning adults of a kokanee population in Lake Sutherland that is known to be producing smolts who pass through the spillway of the dam. There are no hatchery operations for sockeye on the Elwha River.

Steelhead Trout

Steelhead trout, an anadromous race of rainbow trout, are one of the most sought-after sport fish in the state and also support substantial tribal commercial harvest. Because of the tribal hatchery program, the Elwha River is the largest producer of steelhead in the Strait of Juan de Fuca. Although the Elwha ranked

10th among state streams for winter steelhead sport catch in 1987–88, this ranking has declined in recent years (Washington Department of Fisheries [WDF] 1988; WDFW 1993).

Approximately 3,100 winter adults enter the river from an average of 82,000 hatchery smolts released each year (Pacific States Marine Fisheries Council 1995). The Lower Elwha Klallam Tribe operates a commercial in-river fishery for hatchery run winter steelhead; these harvests average 1,450 fish per year for the tribe (PNPTC and WDFW 1994). Sport anglers additionally harvest an estimated 1,150 winter and 355 summer steelhead each year (PNPTC and WDFW 1994).

Sea-run and Resident Cutthroat Trout

Both resident and anadromous races of cutthroat trout were probably present in the pre-dam Elwha River. Sea-run cutthroat trout are a major sport species in the state, although they are less abundant than steelhead in most areas (Johnston and Mercer 1976; DeShazo 1980). A regionwide decline in sea-run cutthroat populations has occurred in the past 15 to 20 years (Trotter 1989).

Sea-run cutthroat are not abundant in the lower river, although they are caught incidentally (fewer than five annually) during other in-river fisheries. Similarly, resident cutthroat trout are not numerous in the upper reaches of the Elwha (Morrill and McHenry 1995), although small numbers were found in the middle reach, particularly in Indian Creek. This population may be related to the large lacustrine native cutthroat that occurs in Lake Sutherland. The Lake Sutherland cutthroat shares characteristics (large body size, spawn timing) with the Lake Crescent cutthroat. It is possible that more isolated populations may be present farther up tributary streams in this system, since cutthroat are often present (Trotter 1989). An introduced population of west slope cutthroat is thought to exist in Long Creek.

Resident Rainbow Trout and Other Species

Rainbow trout and small populations of brook trout (nonnative) occupy the upper Elwha, as well as the reservoirs and middle reach of the river. These are non-anadromous populations of trout, although the impulse for rainbow to migrate to sea may remain.

Other fish that may occur in the Elwha River include threespine stickleback, sculpins, smelt, and sturgeon. Sturgeon are a major commercial and recreational species in Washington, with the most important stocks utilizing the Columbia and Chehalis Rivers. While resident populations occur in the largest Northwest rivers (i.e., the Columbia), most stocks are anadromous. They are occasionally taken in tribal net fisheries in the Elwha River (James River II 1988). See the “Socioeconomic Environment” section for more information about tribal, commercial, and recreational fisheries.

Soils

The mitigation measures analyzed in this SEIS are all located in Clallam County, Washington. No systematic soil survey has been conducted for the specific project area; however, several individual studies that address soils in specific areas have been prepared for aspects of this project and are referenced where appropriate.

A 1987 Soil Conservation Service soil survey for the Clallam County area forms the basis for county data on soils (Crain, pers. comm. 2003) and is used to discuss general soil types and locations within the project area.

Soil is characterized by physical, biological, and chemical processes that result from the interaction of time, parent material, climate, living organisms, and topography (Birkeland 1974). For example, as soil formed in the survey area, unweathered, moderately coarse textured parent material was exposed as the continental ice sheet melted. It is believed that the climate was conducive to soil development during most of the intervening period. Soil development actually begins when organic matter accumulates from the first colonizing plants that occupy a soil surface. Marine sediments and most alluvium, loess, and volcanic ash in the survey area have been involved in soil formation for 7,000 to 12,000 years. On a geologic time scale, the soils in the study area are young.

Bedrock in the study area began as sediment or igneous rock deposited beneath the Pacific Ocean as much as 50 million years ago. The sediment ranges in size from very fine clay and silt to pebbles and cobbles. Uplifting as a result of slow movements and collisions between huge plates of the earth's crust are responsible for the structural formation of the Olympic Mountains.

The oldest established age for coastal Pleistocene glacial deposits is about 71,000 years. The most recent glaciation during which continental and alpine glaciers occupied western Washington (about 18,000 years ago) is the Fraser glaciation, during which most of the foothills and mountains in the area were covered with ice. Glacial drift deposited during this period covered or mixed previous glacial deposits and became the landforms and parent material for many of the soils in the study area. The glacier scoured and removed from the mountains the existing surface material, which was commonly replaced with glacial drift. Glacial scour and erosion from steep slopes exposed fresh parent material. The mountainous landforms and the parent rock are relatively old; however, the soils have formed in unweathered material exposed since the last glaciation.

As sea level dropped around 15,000–20,000 years ago, a broad, vegetation-free coastal plain was exposed along the Pacific Ocean. This area served as a source for loess, which covered much of the coastal area, some areas to depths of 15 feet. About 6,600 years ago, Mount Mazama in southern Oregon erupted, depositing a thick layer of volcanic ash across the area, contributing to the development of identifiable ash-related soil properties in the area.

Since the glacial period, mass wasting, surface erosion, and deposition have further modified landforms. In the Elwha and other major rivers, eroded materials such as sandy gravel, cobbles, and boulders transported by water were deposited as alluvial terraces. Sediment continues to erode from the valley walls and is transported by the Elwha River and its tributaries. While the dams stop the natural flow of sediment to the river mouth, alluvium from below Elwha Dam is stored along the river channel.

Proposed actions addressed in this document include activities along the lower 3.7 miles of the Elwha River and a landfill site in western Port Angeles within the city limits, where the municipal water treatment plant is proposed. Soil map units along the lower reaches of the Elwha River that may be impacted include typic xerofluvents and Neilton very gravelly sandy loam. Clallam gravelly sandy loam occurs at the landfill site.

> *Typic Xerofluvents* — These are very deep, somewhat excessively drained soils that occur on floodplains and in recent alluvium along 0%–5% slopes. Native vegetation is mainly mixed conifers, deciduous trees, and shrubs. Elevation is near sea level to 300 feet. No single profile is typical of this soil unit, but one commonly observed in the survey area is a surface covered with a mat of organic material about 2 inches thick. These soils vary widely in texture within short distances. Permeability is rapid, and available water capacity is low. Runoff is slow, and the hazard of water erosion is slight. These soils are subject to occasional brief periods of flooding from December through April (SCS 1987:68).

Neilton very gravelly sandy loam — These are very deep, excessively drained soils found on terraces and in glacial outwash, and they can occur to elevations of 1,600 feet. Native vegetation consists mainly of conifers and shrubs. In low slope areas (0%–5%), the surface is covered with a mat of organic material 1 inch thick. The surface layer is dark brown, very cobbly, sandy loam 6 inches thick. Permeability is very rapid, and available water capacity is very low. Runoff is slow, and the hazard of water erosion is slight (SCS 1987:48). On steeper slopes organic material is thicker. Available water capacity is very low, and runoff is low. The hazard of water erosion is severe (SCS 1987:47).

Clallam gravelly sandy loam — These are moderately deep, moderately well drained soils found on hills in compact glacial till and ranging in elevation from 40 to 1,800 feet. The native vegetation is mainly conifers and shrubs. Typically the surface is covered with a mat of organic material 2.5 inches thick. Depth to compact glacial till ranges from 20 to 40 inches. Permeability is moderate down to the compact glacial till and then very slow in moving through this level. Available water capacity is low; runoff is medium, and the hazard of water erosion is slight. The effect of the layer of compact glacial till on use and management is similar to that of hardpan (SCS 1987:23).

Vegetation

The Elwha River valley is one of the longest drainages on the Olympic Peninsula, and it experiences a climate transitional between drier conditions to the east and wetter conditions to the west, with a mix of unique plant communities that are adapted to these climatic conditions. Madrone, Douglas-fir / manzanita, and Douglas-fir / grand fir communities on dry, well drained sites represent eastern peninsula vegetation types found in the valley. Forests dominated by western hemlock with an understory of ferns occur on moist sites throughout the valley and are more characteristic of western peninsula vegetation.

Riparian and Upland Vegetation

Most of the study area consists of upland and riparian forest communities, including conifer, mixed conifer/hardwood, and hardwood communities. Upland grassland and deciduous shrub communities are sparsely distributed. Conifers, primarily Douglas-fir, comprise more than 75% of the trees in conifer forests and 25%–75% in mixed forests. Much of the conifer and mixed forest in the study area is second-growth on land that was logged or burned between 40 and 120 years ago, or is disturbed. Conifers comprise less than 25% of the trees in hardwood forests. Hardwood forests are usually dominated by red alder interspersed with big-leaf maple, black cottonwood, and willow. Hardwood forests are common in riparian areas as well.

A riparian zone is defined as the river channel and lands where vegetation is influenced by elevated water tables and flooding, or by the ability of soils to hold water (Naiman et al. 1993). It is the zone of direct ecological interaction between the forest and the river system (Swanson and Franklin 1992).

The riparian zone is ecologically important for many reasons. Long-term studies have found consistently high levels of biological diversity. For example, more species of breeding birds use riparian areas than any other habitat type in North America, and studies in the Cascades have found up to twice the species richness in riparian zones compared to upland habitats (Douglas et al. 1992; Gregory et al. 1991).

Studies have also found that nearly 70% of vertebrate wildlife species in a region use riparian corridors in some significant way during their life cycles (Naiman et al. 1993). The Elwha riparian zone provides, or could provide, important habitat for threatened, endangered, or rare species. A natural riparian zone reduces the severity of flood events, acts as a buffer to pollution sources entering the river, controls the loss of groundwater nutrients into the river, and provides important fish habitat and food sources from overhanging vegetation and associated terrestrial insects.

Riparian zone woody debris entering and accumulating in the river channel creates habitat for aquatic insects, fish, small mammals, and birds, and it influences the formation of pools, river movement, and the overall structural habitat diversity of the river system (U.S. Forest Service [USFS] 1988; Gregory et al. 1991). Extensive research into the ecological role of woody debris has concluded that it is a critical element of river ecosystems (Swanson and Franklin 1992).

In the project area for this SEIS, a riparian zone along the Elwha River from RM 2.8 to 3.7 would be affected by modifying the WDFW fish-rearing channel (RM 2.8–3.0), modifying the industrial channel and outlets for the Elwha water treatment plant (RM 2.8), replacing the existing rock diversion structure and surface water intake (RM 3.5) with a new control weir, temporary diversion, and intake facility (RM 3.65), and floodproofing the existing DCWA well field (RM 3.7) or alternative well field site (RM 3.45). Access road options for the water treatment plant include two alignments that reach the site from the north and one that would improve an existing road from the south. All lie partially or wholly within the riparian zone. An access road to the alternative well field would also cross riparian vegetation. Several pipelines would be built as part of the proposed action: (1) a pipeline to carry water from the alternative well field (if selected) to DCWA customers, (2) a pipeline from the treatment plant to the tribal hatchery, (3) pipeline modifications or additions to carry surface water to the treatment plant, and from the plant to the existing Port Angeles municipal waterline (connects the Ranney collector with the existing water distribution system), and (4) a pipeline from the tribal wastewater collection point to Port Angeles for treatment. All of these lines would lie within some portion of the riparian zone.

Vegetation surveys on both sides of the river from upstream of the existing rock diversion structure (approximately RM 3.6) to slightly downstream of the WDFW fish-rearing channel (approximately RM 2.7) found a mixed conifer / deciduous forest with Douglas-fir, black cottonwood, western red cedar, red alder, big-leaf maple, and grand fir. Shrubs include oceanspray, scotch broom, Oregon grape, snowberry, saskatoon, and Himalayan blackberry, and herbs include false Solomon’s seal, stinging nettles, Siberian miner’s lettuce, and Robert geranium (for a complete listing, contact Olympic National Park).

In the vicinity of the existing rock diversion dam, vegetation and wildlife were surveyed in detail in 2004 (URS 2004b). This is the location of a proposed control weir, new intake structure, access road to the structure, and a temporary diversion channel. The Elwha River in this area flows between two mid-channel islands, one upstream of the existing rock diversion structure and one downstream of it. The floodplain between these two islands is relatively broad, particularly on the west side of the river where the temporary diversion channel would be located. This section of floodplain is about 1,000 feet wide, with many dry side channels used as recreational access roads. Much of the floodplain is disturbed, including an area of undeveloped campsites near the existing intake structure. The proposed temporary diversion channel begins near the upstream end of the southernmost island and continues northward across the floodplain (see “Surface Water Intake Plan,” page 18) following one of these dry side channels through the floodplain forest. The diversion channel continues on past where the old side channel rejoins the river to a spot just west of the northern mid-channel island, a distance of about 1,500 feet. Vegetation is similar to the mixed conifer/deciduous forest that characterizes much of the area between RM 3.6 and 3.3, where the majority of development near the river would take place. Trees species include big-leaf maple, red alder, black cottonwood, bitter cherry, western hemlock, and Douglas-fir. Common shrubs include willows, cascara, trailing blackberry, Indian plum, red elderberry and salal in an understory of sword fern, Pacific bleeding heart, orchardgrass, and other species identified above. Western red cedar is the most common conifer species in the riparian forest.

Douglas-fir and western hemlock are common along valley walls and in the area above the floodplain. This type of habitat occurs on the eastern side of the river in the vicinity of the planned intake and diversion structure. The east bank is steep, with exposed rock close to the riverbank. Access to the new intake would be via a 500-foot road built parallel to the existing Crown Z Water Road along the east bank. In addition to Douglas-fir and western hemlock, which occur above the exposed rock, small madrone trees, Sitka willows, Himalayan blackberry, and Scot's broom grow in open habitat near the exposed rock. Serviceberry is abundant in the small sandy area below the existing intake structure.

A vegetation survey at the Elwha water treatment plant site found similar second-growth, mixed conifer / deciduous forest (URS 2003b). A more in-depth survey of the proposed solids pipeline corridor, which would parallel the north side of the existing overflow channel and would discharge into the river north of this channel, also found young madrone trees and aspen where the soil is relatively dry and exposed to the sun (URS 2004a). In addition to the trees identified above, the shrub layer of this forest includes willows, cascara, trailing blackberry, Indian plum, elderberries, and huckleberries. Both the existing DCWA well field and the proposed Elwha water treatment plant site have mowed grassy areas.

To provide potable water to Elwha Heights subdivision homeowners, three alternatives are being considered.

- One alternative would be to connect to the DCWA system (alternative A). To provide this connection, a pipeline along Rife Road and Walker Ranch Road would be replaced with a larger line, and a new section of pipe across a privately owned piece of property would connect to the DCWA system. Vegetation along both Rife Road and Walker Ranch Road has been disturbed by the roads themselves, lawns, driveways, and other activities, with grasses and forbs such as velvet grass, tall fescue, timothy, thistle, and dandelion. Vegetation in the scrub habitat adjacent to the road is similar to the deciduous/conifer forest described above (e.g., Douglas-fir, western hemlock, red alder, big-leaf maple, salal, Indian plum). Once the pipeline veered away from the road alignment and continued toward Elwha Heights, it would cross through a tree farm growing conifers and hardwoods (Douglas-fir, western hemlock, red alder, red cedar, big-leaf maple, grand fir). Sitka spruce and other conifers have also been planted. Shrubs are typical of deciduous/conifer forest described above. The pipeline corridor would pass through a clearcut area where understory species and shrubs dominate, along with field grasses and forbs, before reentering forested habitat near the connection to the Elwha Heights homeowners pipeline at Edgewood Lane.
- A second alternative would be to construct a pipeline between the proposed Port Angeles water treatment plant and the Elwha Heights subdivision (alternative B). A 6-inch line would parallel an existing 24-inch pipeline along Kacee Way to connect to the plant. The entire line would be about 6,800 linear feet and would lie either within the roadway along Kacee Way or in the roadbed of the Milwaukee Railroad grade. Tree species on either side of the railroad grade include bigleaf maple, red alder, Douglas-fir, and western red cedar. Herbaceous species include clovers, vetches, scotch broom, and other weedy species. Vegetation along Kacee Road includes many common plants along the border, including dandelions, thistles, fireweed, and yarrow. Shrubs and trees include red alder, madrone, black cottonwood, Douglas-fir, western red cedar, salal, scotch broom, and berries.
- A third alternative to provide clean water for Elwha Heights homeowners would be to install a package treatment mechanism in the current pipeline from the city's Ranney well (alternative C).

Filters would be removed and discarded periodically. This alternative would not have any impact to vegetation.

Nearer the mouth of the river (RM 0.1 to 1.6) is the federal levee and the tribal fish hatchery. At the southern end of the federal levee is the Halberg property. This is the site the tribe is considering using for its relocated fish hatchery, as well as for a community wastewater treatment plant and effluent disposal (by means of a constructed wetland) if that alternative is selected. Vegetation consists primarily of an ungrazed pasture with a variety of grasses and common weedy species and two shelter belts of trees on the north and south ends. Tree species in the shelter belts include big-leaf maple, red alder, Indian plum, Douglas-fir, and red cedar. Fruit trees also exist on the property. The levee road in this area and to the southeast is more heavily vegetated, with a second-growth forest on both sides of the road. The forest along the road and on the east end of the property is relatively undisturbed and does not appear to have been logged in the last 30–40 years. Surveys for protected or rare plant species found none, but botanists conducting the survey concluded that the less disturbed nature of this forest may make it habitat for some of these species.

At the north end of the levee (closest to the river mouth), a July 2003 survey found the roadway on top of the levee to be vegetated with species typical of disturbed areas. These included dandelions, pineapple weed, yarrow, and buckhorn. Vegetation in a dune area about 1,000 feet (300 meters) north of the northern end of the levee includes dune wildrye, silver burweed, beach peak, and other species specific to dune habitat. In the area east from the levee for a short distance, riparian species include big-leaf maple, red alder, and black cottonwood, as well as grass species (brome, wheat grass, and bent grass). Continuing south along the levee, the road vegetation is mowed. East of the middle section of the levee some riparian tree species grow, but the understory is grazed and less than 1 inch tall. Some grand fir seedlings have been planted in this area. Otherwise, vegetation to the east is weedy and typical of a disturbed site. Similar conditions exist east of the levee to its southern end. To the west of the levee, riparian forest species grow in the floodplain. Surveys in the spring and summer of 2003 noted that this riparian vegetation does not extend to the western edge of the levee, apparently because of maintenance.

Between the existing southern terminus of the federal levee and the state WDFW hatchery access road to the south lies a heavily forested and relatively undisturbed area. Tree species include bigleaf maple, red alder, Indian plum, black cottonwood, Douglas-fir, and western red cedar. Shrub species include vine maple, oceanspray, red elderberry, snowberry and species of *Rubus,* especially Himalayan blackberry. The forest canopy is dense, and in many areas ground cover vegetation is limited to ferns and true moss. It appears to have been logged many years ago but not within the last three or four decades.

The primary upland location that would be affected is the proposed Port Angeles water treatment plant site, which is adjacent to the city's existing landfill. This approximately 5-acre site consists of bulldozed land, regrowth forest about 20 years old or older, and a small wet drainage on the south. Numerous old roads crisscross the forested part of the site. Forest vegetation is mixed conifer and hardwood species, including Douglas-fir, western red cedar, red alder, big-leaf maple, and grand fir. Herbaceous weed species (including clovers, vetches, stinging nettles, sword fern, and Siberian miner's lettuce) occur on the site, with fewer in the forested area.

Roads, sections of pipelines, and the Elwha Dam trail and overlook would traverse upland areas. For example, a DCWA pipeline connection to the city's municipal water system would lie along Airport Road. A survey of this alignment showed that much of the area is mowed. Trees along the road included black cottonwood, Douglas-fir, aspen, and bitter cherry.

A pipeline to transmit wastewater from the tribe and Valley community residents to the city for treatment could also disturb upland vegetation, although much of the pipeline (two routes are currently under consideration) would run along existing pipeline, railroad, or road corridors. An existing pipeline climbs the bluff east of the river near the location of the WDFW rearing channel and extends along the Milwaukee Railroad right-of-way and Kacee Way. From here, it crosses Lower Elwha Road and enters the Port Angeles city limits. The route continues across Dry Creek and moves eastward along the railroad right-of-way to 18th Street and connects to the city’s infrastructure. A portion of this route could be used for the tribe’s wastewater pipeline. In addition, the tribe is considering part of the route for a new road that might become the primary access to the Lower Elwha Reservation (under separate project analysis in accordance with the National Environmental Policy Act through the Indian Reservation Roads program). If both were located in this corridor, the wastewater pipeline would follow the primary access route up the bluff to meet the railroad right-of-way, then follow that right-of-way for approximately 1.5 miles to the connection site at 18th Street. Tree species on the east side of the pipeline include big-leaf maple, red alder, Douglas-fir, western red cedar, and western hemlock. All of the trees are small because of recent maintenance. The vegetation along the railroad grade is primarily weedy species. A second pipeline route under consideration would follow the Lower Elwha Road in a southerly direction, then use the same easterly route along the railroad right-of-way, as described above.

The vegetation along the proposed route of the Elwha Dam trail is primarily upland, with western red cedar, Douglas-fir, and some big-leaf maple as canopy species. The understory varies, with sword fern dominant in some places, salal elsewhere, and lesser amounts of other native shrubs and herbs typical of forests at this elevation. Some nonnative plants, including Scotch broom, were found to be present. A patch of the noxious weed Bohemian knotweed at the Lower Dam Road crossing would need to be eradicated before the trail was constructed to prevent its spread. The trail alignment crosses two wet areas, one open and one forested. The open area includes salmonberry, thimble berry, Himalayan blackberry, stink current, and horsetail. The understory species in the forested wet area include lady fern, sword fern, salmonberry, skunk cabbage, horsetail, and bleeding heart. The overlook location is forested with western red cedar and big-leaf maple, and the understory is vegetated with sword fern, salmonberry, bleeding heart, and horsetail. These species suggest a wet environment, although surveys of the soil did not show this to be the case.

The vegetation at the location of the proposed chinook holding/rearing ponds on Morse Creek is primarily upland. The creek lies in a narrow, steep valley at this point, and vegetation is predominantly second-growth red cedar and big-leaf maple. Undergrowth consists of alder, salmonberry, sword fern, and trailing blackberry. Outside the immediate area, most land is used for grazing and other agricultural purposes.

Wetland Vegetation

Wetlands modulate river flows during storm events, stabilize banks and erosion, trap sediments, retain nutrients, provide wildlife habitat, and facilitate energy and nutrient flows (Brinson et al. 1981; Adamus and Stockwell 1983). At least three types of wetlands — forest, scrub/shrub, and emergent — are present in the study area. Willow and red alder are the dominant tree species in wetlands; common understory species include salmonberry, Indian plum, and skunk cabbage.

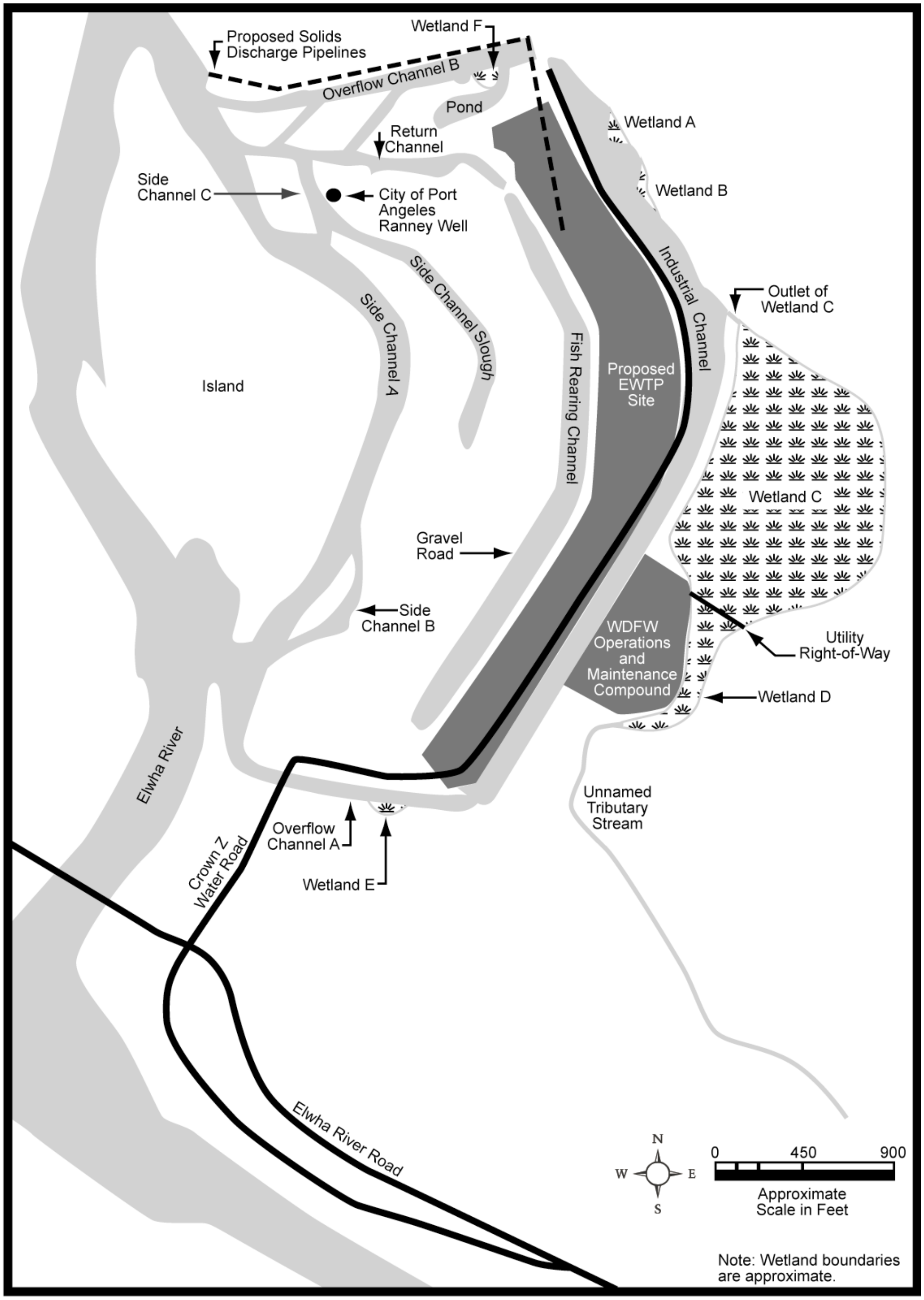
Elwha Water Treatment Plant. A survey in the vicinity of the Elwha water treatment plant site found six wetlands between outflow channels of the WDFW rearing channel to the north and south, just east of the industrial channel to the east, and the banks of the Elwha river to the west (URS 2003b). The classification that Clallam County uses for wetlands is I to IV, where I is the highest quality (Clallam County Environmental Policy 27.12.210).

- Two Class III wetlands at the northern end of the site are emergent wetlands dominated by reed canarygrass and are very small. (Wetlands A and B on the "Wetlands: Elwha Water Treatment Plant Site" figure.)
- Two larger wetlands (wetlands C and D) are part of the same forested and emergent wetland complex and are located east of the industrial channel. Dominant tree species include red alder and western red cedar, with salmonberry, reed canarygrass, and American brooklime present in the understory. One of these wetlands includes large patches of open water, with habitat features such as snags and floating logs, and a stream feeds the other wetland. The two wetlands are separated by a utility line right-of-way. Both are Class I because they are large, have diverse habitat features, and consist of largely native species of vegetation. They are outside the area slated for development, but they could experience indirect effects and could require a 200-foot buffer (Clallam County Environmental Policy 27.12.215). The wetlands are most likely oxbows or disconnected segments of what once was the Elwha River. It is also likely that the industrial channel separated these wet areas from the river.
- The fifth wetland (wetland E) is along the overflow channel at the southern end of the study area. It is a small, class III, emergent wetland dominated by spike bentgrass and American brooklime.
- The final wetland (wetland F) is at the eastern end of the northern overflow channel. It is a small strip wetland with both emergent and forested components dominated by reed canary grass and red alder. Because it is small and has lower diversity, it is a Class III wetland.

Some small wetland areas dominated by these same species were also found adjacent to some of the side channels and sloughs in the area. However, because buffers between construction and the river are mandatory (Clallam County Environmental Policy 27.12.215), they would not be directly affected. Other small wetlands may exist in the vicinity. For example, pipeline leakage along the route of the current Port Angeles municipal pipeline, and the proposed site of other pipelines or road development, has created some wetland habitat, where elodea, duckweed, forget-me-not, dock, and small flowered bulrush have become established.

Four small wetlands exist in the immediate vicinity of the proposed control weir/intake (URS 2004a). There are two small forested wetlands near seeps along the upslope portion of the county's existing access road on the west side of the river. Devil's club, lady fern, youth-on-age, and skunk cabbage grow in the wet soils of these seeps. These wetlands are also in the vicinity of the DCWA alternative well field (URS 2002b). One wetland drains into the pond described below, and the other into a culvert under the road. Both are considered Class III wetlands.

A third wetland on the west bank of the river is very near the existing diversion structure. This small wetland has both emergent and scrub/shrub components and is dominated by creeping buttercup and red canary grass. The scrub/shrub community is dominated by Sitka willow, Nootka rose, and red-osier dogwood. The fourth is another scrub/shrub wetland at the northern end of the northern mid-channel island and is dominated by Sitka willow and red alder. Both of these may have higher value by virtue of both their vegetation and location, but both are quite small and are unlikely used extensively by wildlife or able to provide much in the way of flood modulation or other function.



Wetlands
Elwha Water Treatment Plant Site

DCWA Alternative Well Field. Ponds and side channel habitat, including a string of three interconnected, filled gravel pits about 50 to 100 feet across and less than 4 feet deep exist in the river floodplain southeast of the alternative DCWA well field site.* The northernmost pond is surrounded by emergent wetland, and sedges and rushes grow around the pond edges. Part of the ponds may be affected or need to be filled to raise the well field, although an additional survey is needed to verify this.

If the alternative well field site was selected, one of the five alternative pipeline routes to bring water across the river to users would have to be selected. Wetlands surveys for the five pipeline routes found small forested wetlands and/or riparian habitat to differing degrees. The existing access road to the new well field crosses two small forested wetlands.

- Alternative route A would not affect wetlands, but would require the removal of a few trees.
- Alternative route B would involve tree removal and would have a potential impact to forested wetlands along the cross-country portion of the alignment.
- Alternative route C would only affect the same two forested wetlands as route A, but would otherwise take place within the footprint or along an existing road right-of-way.
- Alternative route D would require a river crossing, which would involve drilling beneath the river, floodproofing the pipeline in the river, or constructing a bridge. Directional drilling for a pipeline under the bridge would result in the removal of some riparian forest or scrub/shrub habitat. Floodproofing could create a change in the function of the floodplain, with impacts to fish or aquatic species, or wetland or riparian habitat. Bridge construction could also result in the removal of riparian vegetation.
- Alternative route E would require some construction along Elwha River Road and could require the avoidance of emergent wetlands along the road shoulder and the removal of a few trees, as well as the construction of a pipeline across the floodplain (Bureau of Reclamation 2003a).

Another option for the Dry Creek Water Association would be to abandon its well field and connect to the city's municipal water supply system. This pipeline route would follow Airport Road for about 3,000 feet. No wetlands were observed along this route, although a natural water spring exists at the upper end of Airport Road.

Elwha Heights. Several small wetlands were identified along the proposed corridor to connect the Elwha Heights subdivision to the DCWA water supply system. A scrub/shrub, class II wetland dominated by Nootka rose and reed canarygrass was found along the west side of Rife Road, and two small, class III emergent wetlands along Walker Ranch Road, vegetated with reed canarygrass, creeping buttercup, and velvetgrass. Three small emergent class III wetlands are clustered near where the pipeline would intercept Edgewood Lane in a clearcut area. One of these wetlands includes a small pool and an aquatic bed community of vegetation, including duckweed and pondweed.

Privately Owned Levee. Currently an emergent coastal wetland on the west side of the river mouth and west of the private levee is prevented from flowing into the Elwha River estuary by the 900-foot levee. This wetland is partially fed by water seeping through the levee during high flows. There may also be saltwater influence because it is separated from the Strait of Juan de Fuca by low-lying sand berms. Modification of the existing levee could result in some fill of this wetland, while relocation of the levee westward or removal could allow this area to reconnect to the river and once again become part of the estuary.

* A report completed by Pacific Groundwater Group in February 1993 for Green Crow Partnership references these three filled pits as gravel pits rather than ponds.

Wildlife

The majority of construction work associated with water quality and water supply mitigation in the vicinity of the Elwha River would take place between RM 2.8 and 3.7. The proposed Elwha water treatment plant would be near RM 2.8, and the existing WDFW fish-rearing channel is between RM 2.8 and 3.0. The existing rock diversion structure and intake is at RM 3.5. The crest of the replacement structure would be located about 225 feet upstream. The DCWA existing well field is at RM 3.7, and the alternative site is between RM 3.4 and 3.5. Downstream, construction would take place at RM 2.0–2.3 on the Halberg property and along the 1.5-mile federal levee. This stretch of river, as well as upland areas where the Port Angeles water treatment plant would be built, were the focus of recent wildlife (and vegetation) surveys.

As noted above, most of the wildlife habitat in this section of the river is a mix of conifer and riparian / deciduous forest with an undergrowth of riparian forbs and shrubs, including willows, blackberry, elderberry, salal, and snowberry in the shrub layer, and lower lying wild ginger, Oregon grape, and sword fern. Some drier sites and shrub/scrub vegetation exist on the valley slopes, and lawns are present at or near the DCWA well field and at the industrial channel. Some small forested wetlands and emergent wetlands exist in the vicinity. Six emergent and/or forested wetlands, including two that are larger with more diverse habitat near the industrial channel, were recently mapped near RM 2.8–3.0 (URS 2003b).

Several additional emergent wetlands, as well as some pond and side channel habitat, occur in the river floodplain near the alternative DCWA well field site and near the outflow of two overflow channels from the existing industrial channel. Wetland surveys for the five identified DCWA pipeline route options (if the well field is relocated) found small forest wetlands and/or riparian habitat to differing degrees, and the connection to Elwha Heights homeowners to the DCWA water system would also include a pipeline alignment that could affect six small, lower quality wetlands. One of these wetlands may serve as wildlife habitat to aquatic birds species.

Habitat in the vicinity of Morse Creek is riparian and upland forest; some previously cleared areas are dominated by grasses and brush.

Mammals

In surveys conducted in fall 2002, and spring or summer 2003, both low-lying riparian or wetland habitat and upland habitats were surveyed for wildlife species. The following descriptions are a result of those surveys and of information from the FEIS and other planning documents for the area.

In the upland areas, as well as in the riparian forests, Columbian black-tailed deer tracks and scat were observed, and their trails were common in and near forest edges throughout the vicinity of wildlife habitat from RM 2.8 to 3.7. Roosevelt elk are known to winter in the forested area adjacent to the DCWA well field and farther north (see the FEIS for more information on this species). Signs of beaver activity in one of the side channels near where the Elwha water treatment plant would be built were also noted, and a river otter was observed near the north end of the existing industrial channel. Although they were not observed, it is known that common mammalian predators in the project vicinity include coyote, bear, cougar, weasel, and mink. Small mammal species either observed or expected in habitat common in the project vicinity include Douglas squirrels, Townsend chipmunks, deer mice, Pacific jumping mice, shrews, moles, voles, bush-tailed wood rats, snowshoe hares, and mountain beavers. These same species likely occupy upland habitat near the Morse Creek site.

While no signs of mammalian life were observed in the site slated for development of the Port Angeles water treatment plant, two black-tailed does and their fawns were seen in the landfill area.

Surveys of the federal levee and options for its extension, as well as of the Halberg property on the reservation where a pump station for treated wastewater would be located, found evidence of deer browsing on cherry and apple trees.

Several species of bats, including little brown myotis, California myotis, hairy-winged myotis, long eared myotis, silvery-haired bat, hoary bat, and big brown bat are associated with forests in the area.

Birds

Between RM 2.8 and 3.7, grassy areas near the DCWA well field and on the grounds surrounding the industrial channel included robins, savanna sparrows, and dark-eyed juncos. Red-tailed hawks and violet-green swallows were observed near the DCWA well field or along one or more of its possible distribution routes. A western flycatcher, which inhabits riparian and deciduous hardwood forest, was seen at this site during a May 2003 survey. Diving ducks (such as mallards and other puddle ducks), killdeer, and red-winged blackbirds may occupy roadside emergent wetlands and side channel ponds along the Elwha River in the vicinity of the DCWA well field and areas to the north.

Surveys of both sides of the river between the existing intake and diversion at RM 3.5 and the WDFW fish-rearing channel at RM 2.8 found that both banks are well used by recreationists. Soils are severely compacted by vehicle traffic. Although some birds were heard in the canopy, none was definitively identified, and very few birds were observed. A more recent survey (URS 2004a) found a great blue heron, a family of common mergansers, and American dippers in the river or along the shoreline near the existing intake structure.

In the river near the WDFW rearing channel, the river has split around a forested island. The flow around the east side of this island was found to contain ducks and other water birds. Surveys conducted in February 2003 reported a great blue heron and a family of common mergansers, hooded mergansers, buffleheads, American dippers, common goldeneye, and belted kingfisher (URS 2003b). In the two larger wetlands east of the industrial channel mallards and a pileated woodpecker were noted. A possible pileated woodpecker roost tree was observed on the valley side slope east of the wetland complex.

Farther downstream surveyors found considerable wildlife activity at the southern end of the levee at the Halberg property. Robins were feeding on cherries from the fruit trees on site; American goldfinches and black-headed grosbeak were also foraging. A single ruffed grouse and an immature red-tailed hawk were observed. A mature red-tailed hawk was soaring overhead and calling to the immature bird, suggesting a nest in the vicinity. One route for extending the levee southeast through the Halberg property was also surveyed. This habitat is extremely dense forest with little open canopy. A pileated woodpecker and Wilson's warbler were observed in this area. Birds along the levee to the mouth of the river were primarily common species associated with urbanized areas (such as the American gold finch and the white-crowned sparrow). Near the mouth of the river and the north end of the levee, turkey vultures, crows, and shorebirds (gulls, cormorants, and a black oystercatcher) were observed. A brood of California quail nested in the vicinity. Although ravens scavenged on recently emptied fish tanks at the tribal hatchery, no other species were observed in the vicinity. Despite this, the Audubon migratory bird surveys between 1994 and 2001 have found a multitude of species at the mouth of the river and along the adjacent shoreline. These include species of special concern, such as bald eagles, Harlequin ducks, and marbled murrelets (see "Species of Special Concern"), as well as ducks (bufflehead, green-winged teal, mergansers), grebes, loons, and several species of raptors (red-tailed hawk, sharp-shinned hawk, Cooper's hawk). A variety of sparrows, finches, vireos, swallows, and warblers were also found in more heavily forested areas.

Forest birds either identified during surveys along the river or in upland areas or known to inhabit the area include American robins, song sparrows, black-capped chickadees, varied thrushes, northern flickers, and winter wrens. Other species considered likely to occur in project area forests include ruffed and blue grouse, mountain chickadees, great horned owls, western screech owls, band-tailed pigeons, red-breasted sapsuckers, and pileated and downy woodpeckers. Shrub/scrub species observed in the upland area of the Elwha water treatment plant included robins, dark-eyed juncos, song sparrows, American goldfinches, house finches, gold-crowned sparrows, and spotted towhees. Spring and summer surveys of the Port Angeles water treatment plant site found violet green swallows, robins, turkey vultures, American goldfinches, flickers, ravens, and many white-crowned sparrows. An occupied red-tailed hawk nest is located on the north edge of the plant site, just inside the forest fringe.

A May 2003 survey of Airport Road (the route for connecting the Dry Creek Water Association to the city's municipal water system) found the same or similar species as at the Port Angeles water treatment plant site — robins, flickers, violet green swallows, and white-crowned sparrows. Other road and pipeline alignments were surveyed. Roads into the Elwha water treatment plant site that would be graded or upgraded were primarily observed to have species associated with urbanized sites. A yellow warbler and cedar waxwings foraged on wild berry bushes along the Kacee Way alignment, and cedar waxwings and dark-eyed juncos were present along the Rife Road alignment. Similar passerine species were found at the Morse Creek site. A recent survey (URS 2004a) confirmed the presence of these same species of birds along the corridor where the pipeline could be replaced to connect Elwha Heights homeowners to a treated water supply. One wetland along this route in a clearcut field was considered large enough to attract birds. Although no birds were observed during the survey, species such as puddle ducks and red-winged blackbirds are considered likely inhabitants.

Lake Aldwell is used as early winter staging habitat (late November through December) by trumpeter swans (Jordan 1995). While the Pacific Coast population of trumpeter swans is neither threatened nor endangered, these birds are of local concern. The swans, which are also known to use Lake Mills, have recently numbered up to 80. Those that spend the entire winter in the Elwha / Port Angeles / Sequim area number approximately 60 (Jordan, pers. comm. Oct. 2003). The Pacific Coast population currently totals approximately 16,300 birds, with 2,000 wintering in western Washington (USFWS 1995a). The swans use a variety of habitat types, including agricultural fields, forested wetlands, ponds, lakes, and estuaries. Although trumpeter swans are outside the study area for this SEIS, they are discussed here because mitigation for the loss of reservoir habitat was not proposed or explored for effectiveness in the FEIS.

Several bird species of concern or with special protected status inhabit the Elwha River valley and may be affected by mitigation activities proposed in this SEIS. They are discussed in the "Species of Special Concern" section below.

Reptiles and Amphibians

Common reptiles in the project area include northwestern garter snakes, common garter snakes, and northern alligator lizards. Northern red-legged frogs and roughskin newts were observed in the vicinity of the DCWA existing or alternative well field sites and in forested portions of the Elwha water treatment plant site. Calls of Pacific chorus frogs and northern red-legged frogs were heard in the vicinity of the wetland complex just east of where the Elwha water treatment plant is planned. Northwestern salamanders, western red-backed salamanders, and tailed frogs (a federal species of concern) were not observed but are considered likely residents of the Elwha water treatment plant site.

Species of Special Concern

Mammals

Pacific Fisher

No federal threatened or endangered mammal species exist in the project vicinity. However, Olympic National Park contains habitat suitable for the fisher *(Martes pennanti)*, a species that is listed by the state as endangered and by the federal government as of concern. The status of the Pacific fisher is not known on the Olympic Peninsula, but is presumed to be rare (Aubrey and Houston 1992). Currently, the fisher is very rare in Washington. Infrequent sightings and incidental captures indicate that a small number may be present. However, despite extensive surveys, no one has been able to confirm the existence of a population in the state. The Washington Department of Fish and Wildlife believes that any remaining fishers in the state are unlikely to represent a viable population, and without a recovery program including reintroductions, the species is likely to be extirpated from the state (Lewis and Stinson 1998).

No evidence of the fisher was reported in any of the four surveys of habitat in the affected area. Although the Elwha valley is considered good fisher habitat, particularly the riparian areas, the last reliable sighting of a fisher in the Elwha River drainage in the study area was in 1975, just outside the park boundary near Herrick Road. There is also a historic record from near RM 22 (WDFW 1995a).

Fisher biology is characterized by low population density and a low reproductive rate. They have extensive home ranges and generally avoid large openings, which suggests that viable populations would require large areas of relatively contiguous habitat. Throughout their range, fishers are generally associated with late-successional coniferous and mixed coniferous/deciduous forests. In western Washington fishers may be restricted by frequent soft snows or deep snow packs to elevations below 6,000 feet. Fishers most likely use forests that have a high canopy closure, multiple canopies, and shrubs, and that support a diverse prey base. Large diameter trees, large snags, tree cavities, and logs are an important component of suitable habitat because they are most often used for den and rest sites.

Bats

Four species of bats are considered federal species of concern; Townsend's big-eared bat *(Corynorhinus townsendii*, formerly *Plecotus townsendii)*, Keen's myotis *(Myotis keenii)*, long-eared myotis *(Myotis evotis)*, and long-legged myotis *(Myotis volans)*. These bats are all associated with mid- to late-seral forests. Townsend's big-eared bats require caves or mine shafts for hibernation and nursery colonies. All exist in the vicinity of the mitigation projects, although none was observed during surveys in 2003.

Birds

Bald Eagle

The federally threatened bald eagle *(Haliaeetus leucocephalus)* has been observed year-round in the area. Bald eagles feed primarily on high concentrations of glaucous-winged gulls and other marine birds along the coast, chinook salmon carcasses in the lower river section, non-anadromous fish stocks in the reservoirs, and carrion, including elk and heron carcasses.

Surveys conducted for the FEIS recorded 14 sightings of eagles (James River II 1990). The survey results and discussions with regional biologists and local landowners indicate that eagle densities upriver decrease with distance from the delta, with very low numbers above Lake Mills. Substantially greater numbers of eagles were detected along the coast than anywhere along the river corridor, possibly because of high prey availability compared to the middle and upper river sections within the study area. The availability of salmon carcasses appears to be an essential food source for wintering and breeding eagle populations elsewhere in Washington (Stalmaster and Gessaman 1984). As noted in the FEIS, the distribution or number of bald eagles along the Elwha River may change when the dams are removed and salmon stocks restored.

Surveys of the sites where development would or might occur during both wintering and nesting periods found no individuals or nests. However, the Strait of Juan de Fuca from Port Angeles to Neah Bay is used by 30 to 35 nesting pairs; two of these sites are just east of the Elwha delta (McMillan, pers. comm. Sept. 1995). Development near the coast, such as for the extension of the federal levee, would have the most potential to impact bald eagles.

The Morse Creek site generally lacks habitat required by bald eagles, as the creek is small and usually partially hidden beneath a dense understory. Bald eagles may use the creek corridor to access the strait or other feeding areas.

Northern Spotted Owl

The federally threatened northern spotted owl *(Strix occidentalis caurina)* typically inhabits unlogged old-growth forests or mixed forests of mature and old-growth timber (Forsman et al. 1984). Northern spotted owl surveys have found seven pairs between the Elwha headwaters and the national park boundary (FERC 1993), two active nests within 2.2 miles of the river and Lake Mills, and at least one additional nest between U.S. Highway 101 and Lake Aldwell, 1.2 miles from Elwha Dam. "Site center" and nesting locations frequently move small distances (generally less than 0.5 mile) from year to year, so that the precise distances from owl sites to the dam sites vary annually. No nest sites in the vicinity of proposed construction of projects for water quality, water supply, flooding, or other actions considered in this SEIS have been located (see USFWS "Biological Opinion," FEIS Appendix 7). Old-growth forest habitat does not exist in the vicinity of any of the construction sites, including Morse Creek, so no owl nesting is expected anywhere in the impact area.

Marbled Murrelet

The federally threatened marbled murrelet *(Brachyramphus marmoratus)* has been observed flying in the Elwha valley and probably nests in the drainage. In western Washington this species prefers to nest in old-growth or large sawtimber forest stands within 39 miles of the coast and below 3,500 feet elevation (Brown 1985). Nesting season in Washington is between April 1 and September 15.

Surveys conducted in 1995 and 1996 within the lower Elwha drainage indicate few birds travel daily north to south through the Elwha valley. No evidence of nesting was found within the vicinity of either the Elwha Dam or the Glines Canyon Dam; the nearest activity occurs in upper parts of adjoining tributary streams such as Boulder Creek, or farther upriver (FERC 1993; Hathorn et al. 1996). No nesting in the vicinity of proposed projects is therefore considered likely. Also, Morse Creek does not have murrelet habitat in the vicinity of the state rearing ponds (Farinas, pers. comm. 2003).

Reconnaissance-level surveys indicate that the Elwha valley between Krause Bottom and the delta serves as a flight corridor between the marine environment and nesting stands along the upper reaches of the valley or tributaries, where an estimated 15 pairs of marbled murrelets bred during the 1990 season.

Harlequin Duck

The harlequin duck *(Histrionicus histrionicus)* is not listed as threatened or endangered, but it is a federal species of concern, which means it is being monitored and could be listed at some future date. Harlequin ducks typically breed in forests adjacent to swift-moving streams. During spring and summer they feed on invertebrates inhabiting the streams. Wintering harlequins feed on snails, limpets, crabs, and chitons in nearshore saltwater areas. Relatively large numbers of the ducks were found near the river mouth in winter surveys in the early 1990s (WDFW 1994). The Elwha River drainage, above and below the dams, is considered prime nesting habitat for the harlequin duck (Schirzto, pers. comm. Oct. 1994), although no nests were sighted in any of the 2003 wildlife surveys of the project vicinity.

Northern Goshawk

The northern goshawk *(Accipiter gentilis)* is both a federal and state species of concern. It is a breeding resident in the project area and occasionally observed year-round. One pair is known to traditionally nest along the Whiskey Bend trail (Sharpe 1990; WDFW 1995a). The goshawk breeds in the dense canopy of mature conifer forests or mixed stands of conifers and deciduous trees. It preys on medium-sized mammals and birds, hunting from concealed perches or while flying. Foraging often occurs at the edges of forests; grouse are an important prey item (Verner and Boss 1980). No goshawks were seen during any of the four wildlife surveys conducted for this SEIS.

Pileated Woodpecker

The pileated woodpecker *(Dryocopus pileatus)* is a state species of concern. It requires large trees and snags for reproduction, as well as for feeding (Schroeder 1983). In the project vicinity, they probably prefer Douglas-fir and deciduous riparian forests with two or more canopy layers (Bull and Snider 1993). These large woodpeckers excavate a new nest cavity each year; old cavities are used by numerous other species in the ecosystem, including saw-whet and screech owls, Vaux's swifts, flickers, chickadees, flying and tree squirrels, wood rats, and bats. Two pileated woodpeckers were identified during surveys for this SEIS — one east of the Elwha water treatment plant site, and a second in the forest east of the Halberg property where the southern end of the levee could be extended.

Amphibians

Northern Red-legged Frog

The northern red-legged *(Rana aurora aurora)* is a federal species of concern. The frog occurs widely west of the Cascade Mountains from British Columbia to California. This large frog lives in forests, damp meadows, marshes, ponds, lakes, and along streams. During rainy seasons, individuals often occupy land away from water, although they prefer mature forests with abundant leaf litter and fallen logs. Red-legged frogs tend to be restricted to lower altitudes. Northern red-legged frogs were observed in some of the wet areas near the existing or alternative well field for the Dry Creek Water Association. Red-legged frogs breed in ephemeral ponds, or perennial ponds that do not have fish. A more thorough survey of affected wetland locations would likely uncover additional individuals of this species.

Tailed Frog

The tailed frog *(Ascaphus truei),* a federal species of concern and a state-monitored species, lives in cold, clear mountain streams in the Cascade Mountains and Coast Range from southern Canada to northern California, as well as in eastern Washington and Oregon mountain ranges and the Rocky Mountains. Tailed frogs are sensitive to stream siltation and warming. They are most abundant in streams in old-growth forests, but can also occupy more open streams. Tailed frogs are likely to occur in forested portions of the site proposed for the Elwha water treatment plant, as well as other affected wetland locations.

Western Toad

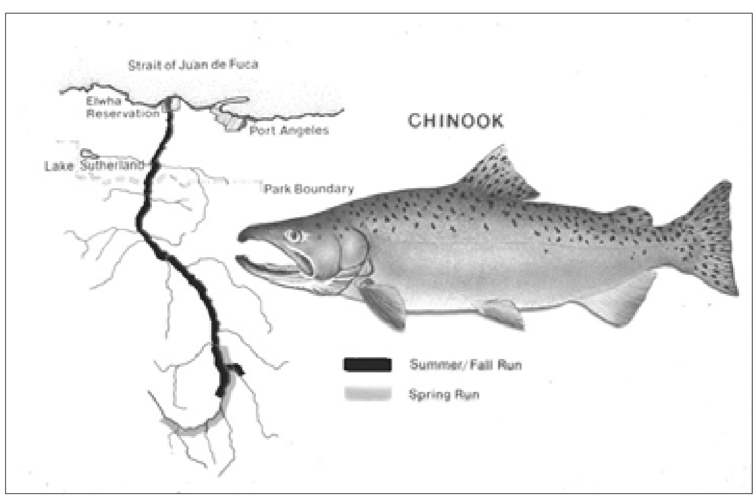
The western toad *(Bufo boreas)* is a federal species of concern. It is a large, robust animal found in all regions of Washington except for the most arid portions of the Columbia Basin. The toads are distributed widely throughout the western United States and Canada. Western toads are most common near marshes and small lakes, but may wander great distances through dry forests or shrubby thickets. Outside the breeding season, this species is nocturnal and spends the day buried in soil, concealed under woody debris, or in the burrows of other animals. Western toads were observed in forested portions of the site proposed for the Elwha water treatment plant, and a more thorough survey of affected wetland locations would likely uncover additional individuals of this species.

Fish

As noted in the "Native Anadromous and Resident Fisheries" section of this SEIS (see page 67), 10 anadromous fish species co-exist in the Elwha River, several of which are offered special protection, or are currently being monitored and considered for this protection. Chinook salmon *(Oncorhynchus tshawytscha)* and bull trout *(Salvelinus confluentus)* are both federal threatened species. Most other Elwha salmon and anadromous trout, including chum *(O. keta)*, pink *(O. gorbuscha)*, and sockeye *(O. nerka)* salmon, as well as coastal cutthroat trout *(O. clarkii)* and Dolly Varden *(Salvelinus malma)*, have been listed as Washington State species of concern, and impacts to these species are analyzed in the "Fisheries" section of the SEIS. Other freshwater or resident species of fish include the Pacific lamprey *(Lampetra tridentatus),* which is a federal species of concern. The Puget Sound / Strait of Georgia evolutionarily significant unit (ESU) of coho salmon was declared a candidate for listing by the National Marine Fisheries Service in 1995. This ESU includes the Elwha River runs of coho salmon.

Chinook Salmon

Chinook salmon are described by the season in which they enter their natal streams to spawn. Spring chinook enter fresh water several months earlier than summer/fall chinook. Before the Elwha and Glines Canyon dams were built, it is believed that chinook entering the river in the spring swam farther upriver to spawn upstream of Carlson Canyon Falls at RM 34. Fish entering in the late summer or fall spawned downstream of RM 34.



Chinook enter the Elwha River primarily from June through September (see Table 7, page 68). Adults require cool water (below 14°C) and medium-size spawning gravel, usually laying eggs in a main channel of the river rather than its side channels or tributaries. Peak spawning occurs from September through mid-October, and adults die within days or weeks after spawning. Juveniles either migrate out their first spring or rear in the river and leave the following May and June as yearlings (Williams et al. 1975). All spend some time in the estuary as they grow and adapt to salt water. Native Elwha underyearlings move into the offshore marine environment in late July and early August (Schroder and Fresh 1985).

Chinook have been regularly stocked for many years. As early as 1930, E. M. Brannon, supervisor of the Dungeness Fish Hatchery, proposed the stocking of chinook in the Elwha. By 1945 the program was fully implemented (*Port Angeles Evening News,* Oct. 3, 1945). The major stock has been the Elwha River summer/fall chinook; spring chinook that were planted in 1973 and 1977 were from Dungeness and Solduc hatchery stocks. Since 1985, approximately 775,000 chinook yearlings have been released annually, with fry and fingerlings totaling 2.6 million fish per year (PSMFC 1995). As shown in Table 8, an average of 2,000 chinook have returned in recent years (1999–2001). The Puget Sound chinook salmon, which occurs in the Elwha River and nearshore marine areas of the river, was listed as threatened under the federal Endangered Species Act in 1995. As a result, fisheries restrictions and other measures were taken to help protect this species.

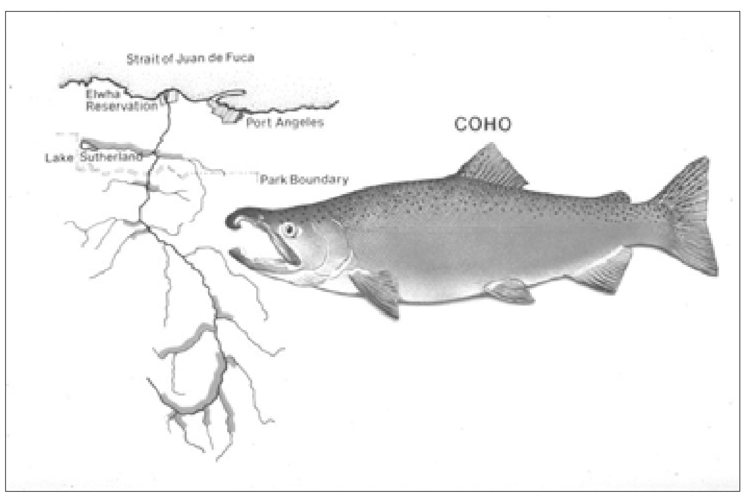
Table 8. Number of Hatchery Chinook Returning to the Elwha River

Return Year	Number of Returning Elwha River Chinook	Return Year	Number of Returning Elwha River Chinook
1992	4,002	1997	2,527
1993	1,669	1998	2,409
1994	1,580	1999	1,625
1995	1,814	2000	1,913
1996	1,877	2001	2,246

SOURCE: PNPTC, WDFW, and Makah Tribe 2003.

Coho Salmon

Coho salmon are a highly prized sport and commercial fish species in Washington State. Currently, Puget Sound / Straight of Georgia coho, which include Elwha runs, are candidates for listing under the Endangered Species Act. The Elwha River, because of its hatchery program, is one of the largest coho producers on the Strait of Juan de Fuca. Even though the run size is less than 1% of the total Puget Sound coho production, it accounts for approximately 35% of the runs returning to the north Olympic Peninsula (WDFW 1995b).



Adults enter the river from September through early January, with some arriving as late as February. Spawning takes place from October into January, primarily in side channel habitats. Adults die shortly after spawning. Most juveniles emerge from the gravel from late winter through mid-spring (Williams et al. 1975; Scott and Crossman 1973). Juveniles live for over a year in the system before migrating to the ocean from late March through mid-June; peak outmigration occurs in May (Wunderlich 1983). Overwintering habitat, which is critical for survival, is often associated with wooded off-channel areas such as ponds and side channels, though main channel pools also are used (Peterson 1980; Peterson and Reid 1984; Swales and Levings 1985).

Coho are typically released from the hatchery into the river as yearling fish in April and May. Recent releases (1990–94) ranged from 400,000 to 800,000 smolts per year. Since 1977, annual coho returns to the Elwha have varied from as high as 16,000 to as low as 1,100 fish, with the majority being hatchery fish. For the 1990–94 period, the average return to the river was just under 3,000 coho per year (Point-No-Point Treaty Council [PNPTC] and Makah Tribe 1994).

Native Char (Dolly Varden and Bull Trout)

In general, native char (Dolly Varden and bull trout) populations in Washington are minor sport species because of their limited abundance in most rivers (although they are quite abundant in some systems, such as the Hoh River). They are widely distributed in the state. Both anadromous and freshwater races exist. Anadromous populations migrate from the sea upriver from May to December (usually August to September). They spawn in the fall and early winter, and fry emerge from April to mid-May. Migrations to the sea begin at age three or four in the spring, and fish return to the same river in the fall, spending only late spring to fall in the marine environment each year of their lives. Like cutthroat, char generally migrate only a short distance from the river in the marine phase (compared to other salmonids) and spend the entire time in tidal water (Scott and Crossman 1973). In systems with lakes, resident fish may similarly migrate, spending summers in the lake and other times in the river (Wydoski and Whitney 1979).

Coastal / Puget Sound populations of bull trout were listed as federally threatened in November 1999. Bull trout are generally not anadromous, but anadromy does occur in many Puget Sound and coastal river populations (USFWS 2000). Bull trout have specific habitat requirements, including cold water, complex cover, stable substrate, high channel stability, and stream/population connectivity. Water temperature influences bull trout distribution more than any other environmental factor (Rieman and McIntyre 1993). It is believed that two subpopulations of bull trout live in the Elwha River. The lower river population (below the Elwha Dam) is probably anadromous and is likely “depressed,” or as determined by the U.S. Fish and Wildlife Service, to have had either a major life history form eliminated, abundance that is declining or half the historic abundance, or less than 5,000 total fish or 500 adults present. Officially, the status of this subpopulation is unknown. Available habitat for this subpopulation includes the 5 miles of the mainstem below the Elwha Dam, and three small, low-gradient tributaries. The location of spawning habitat is unknown.

An upper river subpopulation both between the dams and upstream of the Glines Canyon Dam also exists. Bull trout between the dams are assumed to be part of the upper river subpopulation, but genetic testing to confirm this has not been completed. Bull trout upstream of Glines Canyon Dam use Lake Mills as foraging habitat, as well as more than 50 miles of the mainstem and tributary habitat. Based on surveys, between 240 and 875 bull trout are estimated to live in the habitat above Glines Canyon Dam, and between 65 and 900 bull trout between the dams in the upper river subpopulation.

Pacific Lamprey and Brook Lamprey

Lampreys are jawless fish, with both resident and anadromous life histories. Pacific lampreys (*Lampetra tridentata*) spend most of their lives in freshwater rivers before entering the ocean as adults to feed. Here they grow to 16–27 inches before returning to fresh water to spawn and die. In large river systems, such as the Klamath and Eel, Pacific lamprey may have a number of distinct runs or races, like salmon. Today, Pacific lampreys are primarily concentrated in medium and large sized, low-gradient Pacific streams. The Western brook lamprey (*L. richardsoni*) is nonparasitic and does not migrate to the ocean to feed. It prefers small tributaries, rather than the mainstems of rivers. Throughout its range, the lamprey has been heavily affected by water developments, agricultural and forest land management practices, and rapid urbanization in many watersheds. Several conservation organizations petitioned the U.S. Fish and Wildlife Service to list the Pacific lamprey and three other lamprey species as threatened or endangered in January 2002. Pacific and brook lampreys have been reported in the Elwha River (URS 2002b, 2003b).

State Sensitive Plant Species

All of the areas where water, flood, fisheries, or other mitigation measures might be constructed were surveyed for protected plant species. No federal threatened or endangered species were found, but several species are considered sensitive by the state of Washington (i.e., populations are vulnerable or declining, and they could become endangered or threatened without active management). The species at risk are:

tall bugbane *(Cimicifuga elata)*
spreading miner's lettuce *(Montia diffusa)*
giant helleborine or stream orchid *(Epipactis gigantea)*
false hedge-parsley *(Caucalis microcarpa)*
Dortmann's cardinalflower *(Lobelia dortmanna)*
pink sand-verbena *(Abronia umbellata* spp. *breviflora)*
Cotton's milkvetch *(Astragalus cottonii)*
long-stalked draba *(Draba longipes)*
western yellow oxalis *(Oxalis suksdorfii)*
loose-flowered bluegrass *(Poa laxiflora)*
royal Jacob's ladder *(Polemonium carneum)*
floating bur-reed *(Sparganium fluctuans)*
featherleaf kittentails *(Synthyris pinnatifida* var. *lanuginosa)*

Bugbane and spreading miner's lettuce generally grow in moist forests (Hitchcock and Cronquist 1973). Giant helleborine is a nonshowy orchid that prefers streambanks, seeps, and lake margins. Surveys conducted in 1990 located helleborine between the road to Whiskey Bend and the Glines Canyon Dam, although this population could not be relocated in a 1995 survey. False hedge-parsley grows in rock outcrops and was located in 1995 near the Glines Canyon Dam and downriver. Surveys in February, May, and July of 2003 failed to locate individuals or populations of any of these species; therefore no impact analysis is included in this document.

Air Quality

Ambient air pollutant concentrations for the Olympic National Park region are within national, state, and local air quality standards. This attainment status may be attributed to the low population density and the lack of many major, older industrial pollution sources. Sulfur dioxide, nitrogen oxides, and suspended particulate matter from coal-fired power plants, refineries, and pulp and paper mills are the air pollutants of principal concern.

The U.S. Environmental Protection Agency has set health-based standards for six air pollutants: ozone, nitrogen oxides, fine particulate matter less than 10 microns in diameter (PM_{10}), carbon monoxide, lead, and sulfur dioxide. Clallam County and the project site are designated as attainment areas (i.e., concentrations below the standards) for all criteria pollutants. This designation is based on representative ambient air quality monitoring.

Concentrations of air pollutants in the study area are influenced by sources of emissions and the dispersion by weather patterns of the region. Major sources of air pollutants (greater than 100 tons per year or 0.907 metric tons) in Clallam County are the Nippon Paper Industries and K-Ply mills. Silvicultural burns, smoke from wood-burning stoves, dust, and other particulate matter generated from vehicles on unpaved roads, vehicle exhaust, and smoke from campfires also affect the air quality in the middle and lower Elwha valley area and Olympic National Park.

The Prevention of Significant Deterioration (PSD) program is designed to allow growth in areas of good air quality without allowing pollutant concentrations to exceed the ambient air quality standards. Because of its unique nature, Olympic National Park has been designated a PSD Class I area. Class I areas receive special air quality protection. To ensure that park air quality remains good, sulfur dioxide, ozone, and visibility are monitored within the park. Sulfur dioxide and ozone are pollutants of concern because these pollutants affect visibility, and many plant species in the park are sensitive to these pollutants. Clean offshore air flowing onto the Olympic Peninsula maintains the near pristine air quality of the national park. However, the park is subject to episodes of smoke and particulate matter pollution due to slash burning on adjacent lands and occasional forest fires. These short-term events affect visibility, but have only limited impacts on other park resources.

Noise

The study area and the surrounding region are relatively quiet, with few sources of noise. Within the study area natural quiet is affected by recreational uses and vehicle access, particularly from the existing and alternative DCWA well field sites downstream to the WDFW fish-rearing channel. Casual roads, trails, and bike paths are common in floodplains until a high flood washes them away. Picnicking, hiking, fishing, and boating all occur along the river and its edges in this vicinity. Roads down to the river, crossing the river, or along the river to access facilities such as the existing DCWA well field, Ranney collector, and fish-rearing channel all carry traffic. Farther downstream, there is a road on the top of the federal levee, and many tribal residents live east of this levee. About 25 residents live on the west side of the river behind a private levee. The lower Elwha River valley supports residential, logging, and agricultural activities. Natural sound levels are also affected by occasional aircraft overflights.

Ongoing landfill operations, as well as the nearby airport, are sources of noise at the site of the proposed Port Angeles water treatment plant.

The Morse Creek site lies in a rural valley with few sources of noise.

Cultural Resources

The Elwha River valley is rich in cultural resources that include buildings, structures, landscapes, traditional cultural properties, ethnographic resources, and archeological sites. These resources represent a long, continuous human occupation and demonstrate the importance of the Elwha River, which has provided sustenance to the valley's inhabitants while serving as a transportation corridor into the heart of the Olympic Peninsula.

The Elwha River valley is the homeland of the Lower Elwha Klallam people. Elwha Klallam villages were located adjacent to important fishing stations at Ediz Hook, the mouth of the Elwha River, and the confluence of Indian Creek and the Elwha River. Settlements and seasonal camps for fishing and other subsistence activities were located along the Elwha River and its tributaries and along the shores of Freshwater Bay and Ediz Hook. The Elwha Klallam hunted for elk, deer, and other game and gathered berries, roots, and plant materials along the bottomlands of the Elwha. Their use of the valley extended upriver through the headwaters to include subalpine and alpine landscapes deep within the Olympic Range.

Euro-Americans began to settle and acquire lands in the lower Elwha valley in the 1860s; the Elwha Klallam were not considered citizens and were not allowed to purchase land in their own homeland. In 1884 the passage of an effective Indian homestead law allowed the Elwha Klallam to acquire legal title from the United States for their homesteads. While Indian homesteaders cleared lands, engaged in farming and stock raising, planted orchards, and raised crops and animals for sale to merchants and others in Port Angeles and the surrounding region, the Elwha River fisheries remained the mainstay of their economy.

The river provided not only the resources for sustenance and lifeways of the Elwha Klallam, but was at the heart of their ceremonial, cultural, and spiritual existence. Construction of the Glines Canyon and Elwha dams decimated fish runs critical to their livelihoods and flooded villages, fish camps, homesteads, medicinal plant and food gathering and preparation sites, and probably burial sites. Some of their most important spiritual sites were (and still are) made inaccessible by the dams or the reservoirs.

Euro-American exploration of the Elwha River valley began in the latter part of the 19th century, and by the end of the century a number of Euro-Americans were homesteading in the valley, drawn by the river and the area's resources. Conditions on the Olympic Peninsula such as dense vegetation, and a climate that restricts crop selection and shortens the growing season, limited the potential for homesteading, and farming never went much beyond subsistence. Mining, logging, and other development activities eventually declined on lands set aside for the Olympic Forest Reserve in 1897, Mount Olympus National Monument in 1909, and Olympic National Park in 1938. In the 1930s the Forest Service was charged with protecting national forest lands, which it accomplished by creating a vast network of trails, shelters, guard and ranger stations, and other buildings and structures. Devising and constructing this network of facilities was a tremendous effort in terms of human and fiscal resources. It represents an important period of growth and development of the Forest Service on the Olympic Peninsula.

The Elwha and Glines Canyon dams, hydropower plants, and associated facilities are now listed on the National Register of Historic Places as historic districts. Ongoing research suggests that the dams are part of a larger cultural landscape that extends from the Lake Mills reservoir above Glines Canyon Dam to the Elwha Dam, including Olympic Hot Springs Road. Several other resources listed on the national register reflect the role of the federal government in the Elwha River valley (the Elwha Ranger Station and campgrounds). The Elwha Ranger Station, the Altair campground, and the Elwha campground continue to be used for their originally intended purpose.

The Elwha Ranger Station Historic District, with its residential, administrative, and utility buildings and structures, was built between 1930 and 1936 by the U.S. Forest Service. The district represents the stewardship efforts by the Forest Service to manage its lands on the peninsula as the federal agency striving to establish a presence in the wilderness. The complex consists of 14 buildings in two main clusters bordering the Elwha River Road. The ranger station and three residential buildings with accompanying outbuildings lie just east of the road. All but one structure is wood frame. Most are capped with gable roofs and are sheathed with either horizontal half-log siding, or horizontal channel drop siding. The buildings in this group were constructed in the early to mid 1930s and express definite features of the bungalow/craftsman style of architecture. All of the buildings contribute to a sense of time and place that speaks to an earlier era of forest management rarely found today in the national park.

The Elwha Ranger Station Historic District is significant for its association with politics and USFS activities within what is today Olympic National Park. The district also is an example of the distinctive type of architectural style used by the Forest Service in its years of managing the national forest lands on the Olympic Peninsula prior to the establishment of the national park. The district has integrity of location, setting, design, workmanship, materials, feeling, and association, and it meets the registration requirements set forth for these properties in the multiple property documentation form.

No prehistoric cultural resources eligible for the national register are currently known to exist in the project area (see the "Affected Environment: Cultural Resources" in the 1996 FEIS for more detailed information on the cultural history of the study area); however, ethnohistoric and ethnographic accounts abound with details of the Elwha Klallam's use of the river valley. The lack of physical evidence of this use is due to several factors, including dense vegetation and the dynamic nature of the pre-dam Elwha River. Additionally, detailed cultural resource surveys up to this point have focused mostly on the river floodplain, where river dynamics make the preservation of prehistoric archeological remains unlikely.

Beginning in the fall of 1994 and continuing into the early spring of 1995, a detailed cultural resources survey of portions of the project area was undertaken (Schalk et al. 1996). The survey team included Lower Elwha Klallam Tribe members, tribal consulting archeologists, and Olympic National Park cultural resource staff. The survey was limited to areas of the project owned by the federal government, tribal land holdings, and some project lands. Individually owned private lands were not inspected as part of this project. A total of 18 cultural resource sites and three cultural resource isolates were recorded during the survey. All of these resources are associated with the historic period. Four properties, including two homesteads, a cabin, and a refuse dump, appear to meet eligibility requirements for the national register; the remaining properties were deemed ineligible.

Other cultural resource field surveys in the area include a 1983 cultural resources survey of the location where Morse Creek chinook-holding ponds would be located (Daugherty and Welch 1984). This project found no significant cultural resources.

More recently, a small survey and monitoring project for the Elwha water treatment plant found no evidence of cultural resources within its project area (URS 2003b). Additional surveys of the sites of the Port Angeles water treatment plant and the Elwha surface water intake facility, and a surface survey of the proposed pipeline alignment for Elwha Heights water connections (URS 2004b), found no evidence of archeological, historic, or other cultural resources. These 2004 surveys included 10 test pit trenches and the monitoring of eight geotechnical borings.

A 1995 survey of the entire river valley below the dams (Schalk et al 1996) found that the chances of locating prehistoric or archeological sites would be poor because most of the project area is in the floodplain. In addition, many of the proposed development sites — including the Elwha and Port Angeles water treatment plants, federal levee extension, some of the pipeline routes (notably a long portion of the tribal wastewater distribution pipeline to Port Angeles, and a pipeline connecting the existing Port Angeles water distribution system to the DCWA distribution system), and some of the possible access routes to these facilities — are already disturbed and unlikely to have any intact cultural resources. However, as noted above, cultural resource surveys or other means of protecting site-specific resources are part of the programmatic agreement between the park, the tribe, and the state historic preservation officer.

In a recent feasibility study, specific well field sites considered as options for the Dry Creek Water Association were visited (URS 2002b). Cultural resource studies conducted at these sites, coupled with a review of Schalk et al. (1996), resulted in the determination that no evidence of archeological materials or features was apparent at either the existing or the alternative well field site.

A 1983 cultural resource survey of the location where the Morse Creek chinook holding ponds would be located found no significant cultural resources. The Washington State Office of Archeology and Historic Preservation indicated at that time that a project similar to the proposals considered in this SEIS would have no adverse effect on archeological or historic sites eligible for inclusion on the National Register of Historic Places (Farinas, pers. comm. 2003).

Socioeconomic Environment

For the purposes of this SEIS, only information pertinent to a cost-benefit analysis is presented in this section; more information on the county's economic base is available in the FEIS. Generally, this SEIS does not update information presented in the FEIS unless there have been major changes with bearing on the selection of an alternative. Since 1996 economic changes include the purchase of the dams by the federal government and increases in the cost of electricity. However, the choice to remove the dams and the choice to manage sediments as described in the FEIS have not changed as a result. As noted in the "Purpose and Need," the focus of this SEIS is on the mitigation measures needed to prevent additional impacts to water users, fisheries, and residents in the floodplain. Because costs associated with the entire project have changed as a result of these mitigations, the SEIS presents updated information on the benefits as well.

Clallam County

Clallam County encompasses an area from just east of the city of Sequim westward along the Strait of Juan de Fuca to the most westerly point of land in the continental United States, Cape Flattery, and south to the town of Forks. Port Angeles is the largest city in the county. The county also contains a major portion of Olympic National Park. Four treaty tribes — the Elwha Klallam, the Jamestown S'Klallam, the Makah, and the Quileute — have reservation lands in Clallam County.

Most of the county's population is concentrated around Port Angeles and Sequim. Port Angeles continues to be the population center of the county, accounting for over 32% of the total. Factors that contribute to this concentration include industrial, recreational, and tourist activity associated with Port Angeles' deep water harbor; the "rain shadow" which makes the climate in the east end of the county more attractive; and landownership patterns that put most of the south and west areas of the county in large commercial timber holdings or in Olympic National Park.

The county's growing tourist industry serves many visitors drawn by Olympic National Park; ferry access to Victoria, British Columbia; salmon fishing; and opportunities to enjoy the varied scenic and recreational amenities in this area. More recently, the county's growing retirement community has created employment gains in the service sector of the economy (White et al. 1992).

The 1990 census estimated Clallam County per capita income at $12,755; county unemployment stood at 8%. Median household income increased from $16,890 in 1980 to $25,434 in 1990. Consistent with national trends, earned income from employment in the county declined from 59% to 50% of all income from 1980 to 1988.

County employment was estimated at 23,310 persons out of a potential workforce of 25,500 in May 1992 (White et al. 1992). The highest growth in employment between 1985 and 1990 was in the government, retail/wholesale, and construction sectors. Clallam County has lagged behind the state in employment growth, but has exceeded the state in the retail/wholesale and government sectors. Poverty levels in Clallam County were almost 2% higher than for Washington State as a whole in the 1990 census.

The government of Clallam County operated on a 1993 budget of $14.8 million (Gerdon 1994). Of this amount, $4.3 million came from property taxes and $2.1 million from sales tax payments to the county's general fund. The 1994 property tax from structures associated with the Glines Canyon Dam was $116,000, and with structures at the Elwha Dam, $114,000 (Gerdon 1994).

Fisheries and Fish Processing

Commercial and recreational fishing have been a cornerstone of Clallam County's economy. Three sectors exist in the commercial fishing industry — fishing, processing, and retail. The fishing sector primarily involves the direct harvesting of fish by private non-tribal and tribal fishermen. The processing sector consists of wholesale cleaning, preparing, and canning of fish. The retail sector characterizes the final sales to consumers through retail markets and restaurants. Since 1980, prices per pound for all salmon stocks analyzed have declined, in some cases dramatically. This is in large part due to the increase of salmon fish farming operations in the United States and abroad (Carr, pers. comm. Jan. 2003), which has reduced the prices for traditional commercial fishermen (Crain, pers. comm. 2001). The benefits of these three sectors to the local economy are presented in Table 9.

Table 9. Benefits of Clallam County Commercial Fishing in Real 2001 Dollars

Sector	Benefit — 3% Discount Rate	Benefit — 7% Discount Rate
Fishing	$12,177,692	$5,335,345
Processing	$ 6,461,632	$2,831,530
Retail	$ 5,557,749	$2,435,443

Economic benefits associated with sportfishing are based on the net revenue increase to the commercial sportfishing industry associated with increased harvests after the restoration of the Elwha River. Information on the average trip expenditure weighted by the number of residents and non-residents and by the type of trip each usually takes (charter, private, rental, shore, etc.) showed an average trip expenditure of $58.99 (Carr, pers. comm. Jan. 2003). Translating this into dollars per fish caught ($108.24) indicates the benefits to the region of sportfishing from the Elwha River is currently about $9.5 million in 2001 dollars (discount rate 3%).

Recreation/Tourism

Recreation and tourism play a major economic role for Clallam County and the Elwha River drainage. In 1993 annual jobs and annual payroll in the travel and tourism sector accounted for approximately 2,000 jobs and generated $21.3 million. Clallam County tax receipts from this sector were estimated at $1.4 million in 1993. These figures are expected to increase slowly over the long term. Travel and tourism expenditures in Clallam County in 1993 amounted to $116.9 million. Related payroll income was $18.8 million.

Principal visitor attractions are Olympic National Park, saltwater sport fishing in the adjacent ocean, and tourist travel to Olympic Peninsula sites and to Victoria, Canada. More than 4,000 accommodation units are available within the county, including hotels, motels, and campgrounds. This sector of the Clallam County economy is expecting significant growth in the future (White et al. 1992).

Lower Elwha Klallam Tribe

The Elwha Klallam people played a substantial role in the area's early economy: homesteading in the late 1800s, selling fish to settlers, and working in the lumber camps and mills in the early 1900s. In 1910 construction on Elwha Dam began. Although this structure and the Glines Canyon Dam (completed in 1927) provided electricity for milling forest products at Port Angeles, they also preempted the greatest part of the salmon resource secured to the Elwha Klallam by the Treaty of Point No Point, severely affecting the tribe's social and economic well-being. Preemption by Elwha and Glines Canyon dams of the treaty fisheries that were secured to the tribe has combined with an almost total lack of effective access to alternative economic opportunities, leaving the Lower Elwha Klallam Tribe today relatively economically disadvantaged.

Tribal social circumstances have paralleled economic difficulties. Tribal society exhibits significant social support for its members, particularly on reservations and through extended families; however, Bachtold (1982), specifically referencing the Lower Elwha Klallam and other Northwest tribes, reports strong linkages between economic well-being, health, and self-worth and concludes that continuing economic deprivation creates overwhelming stress among tribal members.

The tribe continues to operate a fish hatchery for chinook, coho, and steelhead on the lower Elwha, and it considers the fishery potential of the Elwha River its most significant economic asset. Most tribal fishers presently rely on the river's fisheries to some degree to obtain a relatively small amount of income and/or food each year.

Ediz Hook

Port Angeles's deepwater harbor is protected from storms by Ediz Hook, a natural sand barrier that encircles the harbor from west to east. Ediz Hook was formed with material eroded from adjacent sea bluffs and from Elwha River sediment deposition. Over the years, construction of dams on the Elwha and erosion control measures on the sea bluffs have substantially reduced natural recruitment of material to Ediz Hook; consequently, the hook now loses more material to wind and wave action than it receives. As a result, in 1978 the U.S. Army Corps of Engineers installed a rock-based blanket to reduce erosion of Ediz Hook at a cost of $5.6 million. Repair and maintenance costs approaching $100,000 per year are expected to control further erosion.

Public Health and Safety

The 1996 FEIS noted several issues of critical importance regarding public health and safety, including earthquake potential, dam safety, and hazardous materials. Since 1996, mitigation measures related to impacts of dam removal have been developed. Measures that could affect public health and safety are those designed to address anticipated impacts to water quality / supply, wastewater utility improvements, and fish restoration. The proposed mitigation actions that could affect public health and safety relate to worker safety and the use or handling of hazardous materials.

Worker Safety

Construction activity related to proposed mitigation actions would include industrial and municipal water treatment plants, associated distribution and roadway systems, the removal and replacement of intake and diversion structures related to water treatment, and improvements of tribal wastewater systems, well drilling, and culvert replacement. These actions could affect the health and safety of construction workers.

According to the Bureau of Labor Statistics (2003), over 1,200 construction workers were killed in 2002 while on the job. These studies focus on general construction categories such as heavy construction (roads, structures, pipelines), special trades (plumbing, electrical, etc.), and transportation, all of which are involved in this proposal.

Construction activities for water quality mitigation are expected to last approximately two years. A variety of earthmoving and excavating equipment would be used, including trucks (premix concrete, flatbed equipment, materials delivery, power utility, trash), and worker transportation vehicles. According to the University of Michigan Transportation Research Institute (2003), the frequency and reasons for fatal accidents involving heavy trucks varies, depending on factors such as drivers, equipment, time of day, and environmental conditions. Statistically, the greatest number of fatal accidents occurred in June, with about two-thirds of them in rural areas (much of the study area would be considered rural). In the United States, approximately 35% of all fatal accidents involving trucks occur on local trips (a 50-mile radius).

In Washington State approximately 57% of vehicle accidents occur in dry weather, and 33% in wet weather (snow and icy weather contribute to still smaller accident percentages). Based on state data, Clallam County had 629 vehicular accidents with eight fatalities in 1996 (Washington State DOT 2003).

Hazardous Materials

The operation of both the industrial and the municipal water treatment plants would require the handling and use of chemicals including liquid aluminum sulfate, liquid and dry polymers, liquid sodium hypochlorite, and potassium permanganate. These chemicals require safe handling, storage, and use, much of which is regulated primarily by the federal and state governments. Onsite process control and monitoring laboratories would use standard reagents necessary to monitor the water plants and ensure safe operation, worker safety, and environmental protection.

The use of motorized equipment (all types) in construction activities and routine facility operations would involve the use of petroleum products, and consequently, the potential for hazardous spills and leaks. As such, chemicals could jeopardize public health and safety, and appropriate handling and proper equipment maintenance are critical to prevent accidental releases into the environment. Adequate and timely spill containment and clean-up procedures would prevent a small accident involving hazardous materials from becoming a much larger problem for public health and safety.